ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

Vol. XXXIII, No. 19.

TABLE OF CONTENTS.

ENGINEERING NEWS OF THE WEEK..... 297

Twelve-Wheel Freight Locomotive, Southern Pacific Ry. (illustrated)..... 298

An Instance of the Value of State Topographical Surveys..... 299

The Measurement of Live Load Strains on Bridges (with inset, illustrated)..... 300

The French Aluminum Torpedo Boat..... 303

Experience with Australian Hardwood Pavements..... 307

Finding Moment of Inertia of Rolled Sections of Varying Size (illustrated)..... 308

Cost of Dredging in the Lower Danube..... 308

Locked Tents for Engineers and Surveyors (illustrated)..... 309

Studies for a Water-Works Intake at Buffalo... 309

Steam Pipes for Marine Engines..... 310

Failure of the Dam of the Bouzey Reservoir, France..... 312

Book Reviews..... 312

EDITORIAL NOTES..... 304

The Test of 18-in. Armor Plate—Trade Possibilities in China—Sanitary Condition of City Slums—State Aid to Railways in France—Civil Service Examination for a Chief of the Philadelphia Water Bureau.

EDITORIAL.

The Free and Promiscuous Distribution of Government Publications..... 305

LETTERS TO THE EDITOR..... 306

Elevation for Race-Track Curves—Test of an Electric Railway Power Station—Wood Preservatives—The Distinction Between Concrete-Iron and Iron-Concrete—Failure of the Angels Masonry Dam, Calaveras County, Cal.

The Alpine tunnel, 34 miles east of Gunnison, Colo., on the Denver, Leadville & Gunnison Railway, is being again opened to traffic, after being closed for about five years. This tunnel is about 12,000 above sea-level, and in winter especially it is difficult to keep it open. The Union Pacific, after operating it for some time, abandoned it some five years ago, and the receiver of the Gulf system is now draining the tunnel preparatory to resuming traffic through it. This tunnel is erroneously quoted by the daily press as the highest in the world. The Galeria tunnel, on the Central Peruvian Railway, has an elevation of 16,645 ft. above sea-level; and Oroya, the present terminus of the line on the eastern slope of the Andes, has an elevation of 12,178 ft.

The Queen Lane reservoir, recently completed in Philadelphia, and about which there was considerable scandal, leaks badly in the bottom. The blame is laid upon the clay lining covered with brick, and lining with asphalt is being considered. The city has not yet officially accepted the reservoir and the present Director of Public Works says he will hold the contractors responsible for the leaks and their repairs. Director Thompson wants $250,000 to make this and the new Roxborough reservoir hold water.

The Daniels corrugated steel ties used in the construction of the New Castle Street Ry. on Mill St., New Castle, Pa., are stated by Mr. J. H. Miller, City Engineer, to be giving good satisfaction. The track and pavement are both in better condition where the steel ties are used than where the track was laid on wooden ties. The cars were run over the portion of the track where these ties were placed within four days after the concrete was laid. This tie was illustrated and described in our issue of Nov. 15, 1894.

The most serious railway accident of the week was a head collision on the St. Louis, Iron Mountain & Southern Ry., near Clarksville, Ark., May 5. A freight train was waiting for orders at Clarksville, and the engineman and fireman left the engine. Apparently the throttle was open, for the engine started off and ran wild until it met a passenger train. Both engines were wrecked and several cars were damaged, while 13 persons were injured, none fatally.

A trestle on the Oregon Pacific R. R., near Chitwood, Ore., gave way under a freight train on April 29, about 15 cars and the caboose going down with the structure. One man was killed and another was injured.

Two terrible cyclones have occurred during the past week. On May 2 a cyclone struck the earth near Patterson, Kan., and continued for a distance of about 16 miles, blowing down houses and trees within a path over 100 ft. wide; 11 people were killed. A much worse disaster occurred in Sioux county, Ia., May 3, the cyclone blowing down several schoolhouses and other buildings in a number of small country towns. More than 100 people were killed, and the damage to property and crops was very extensive.

The lakes at the Cotton States & International Exposition, at Atlanta, Ga., will have an area of about 13 acres and will contain about 50,000,000 gallons of water. They will be filled by the Atlanta waterworks. It is estimated that it will take 30 days to fill the lakes by the three 6-in. mains.

The test of an 18-in. Harveyized armor-plate at Indian Head, on May 1, was a conclusive and remarkable victory for the plate over our heaviest modern guns. The plate, made at the Carnegie Works, was 16 ft. 9½ ins. long, 7 ft. 5 13-16 ins. wide, and was 18 ins. thick for 4 ft. from the top, and then tapered to 8 ins. at the bottom. Its weight was 79,300 lbs., and it represented the second lot of 306 tons of side armor for the battle-ship "Oregon." It was backed by 36 ins. of oak, attached by 26 3-in. bolts. The range was about 300 ft. The first projectile fired against it was a 12-in. Holtzer shell, of 850 lbs., driven by 249.8 lbs. of brown hexagonal powder, resulting in an initial velocity of 1,465 ft. per sec. and an energy of 12,662 ft.-tons. The plate was struck by this "cracking shot" 78 ins. from the left edge and 38 ins. from the top. The point of the shell penetrated about 6 ins., causing a bulge in the plate ½ in. high and extending about 3 ins. around the hole; but no crack of any kind appeared. The 850-lb. shell was crushed to fragments. The second trial was for "penetration," and a similar 12-in. shell was backed with 443.4 lbs. of powder, imparting a velocity of 1,926 ft. per sec. and developing a striking energy of 21,885 ft.-tons. This shell struck 42 ins. to the right of the first hole and penetrated about 10 ins.; the head of the projectile was smashed and welded to the plate; and for a depth of 3 ins. and for 6 ins. around the hole the metal in the plate had fused. A crack, ¾ in. wide, was developed in the surface of the plate, extending from top to bottom. The plate, having very successfully withstood both tests, was accepted by the government. But to determine its ultimate resistance, it was again fired at by a 13-in. Carpenter projectile of 1,100 lbs., driven by 480 lbs. of powder with a velocity of 1,810 ft. per sec. and the enormous striking energy of 25,000 ft.-tons. This projectile struck 32 ins. to the left of the first shot. Instead of demolishing the plate, as expected, this shell penetrated only 10 ins. and was "pulverized," with the result that a crack 3 ins. wide extended down some distance from the top. The "smashing" effect of the shot was very apparent, however, as the oak backing was crushed into kindling wood. Only one of the fastening bolts was damaged; the other 25 holding the plate securely.

A complete sewerage system has been constructed for Brunswick, Ga., within about a year. The system is on the separate plan and includes 21¾ miles of 8 to 24-in. pipe, and a pumping station. The use of agricultural drain tile in the sewer trenches is credited with lowering the ground water 3 ft., or from 1½ to 4½ ft. below the surface. Messrs. Waring, Farquhar & Chapman, of New York and Newport, were the engineers, and Mr. Herbert Tate, of 21 East 20th St., New York city, was the contractor.

The forestry exhibit at the Cotton States and International Exhibition at Atlanta, Ga., is to be in charge of Mr. B. E. Fernow, Chief of the Forestry Division of the U. S. Department of Agriculture, and he promises a complete and instructive exhibit. Mr. Fernow says that the exhibit of the Forestry Division will occupy about 3,000 sq. ft., and that it is intended to make it even more valuable, from a commercial point of view, than the exhibit at the Columbian Exposition. There will be an extensive exhibition of Southern woods and wood products, a turpentine orchard showing the present wasteful methods and the more approved methods of collecting turpentine, and an exhibit of the timber-test work which has been carried out for some years, and most of which has thus far been in connection with Southern timbers. The checking of shifting sands by planting grass, and the various methods of reclaiming land rendered arid by the washing away of the soil by floods, will also be among the things shown in connection with the exhibit.

A double-turret arrangement is recommended by the Bureau of Ordnance for the new battleships authorized by Congress. By this plan the 8-in. guns would be mounted above the 13-in. guns, and the advantages claimed are concentration of gun-fire, reduction in general weight, and better protection for the ammunition hoists of the 8-in guns. On the battleship "Indiana" these hoists are protected by 3-in. armor only; in the new plan they would have 15 ins. of armor about them, and they can be made larger. Waste space in the 13-in. turret is also thus utilized, and there is a large saving in weight by eliminating the separate 8-in. gun turrets with their separate fittings. If the double-turret plan had been adopted for the "Indiana" there would have been a general saving in weight of 440 tons, while just as good a gun-fire would have been retained. Under the Bureau's plans the maximum sweep of the guns is 270°, and the broadside which can be given by a ship so fitted is 5,820 lbs. of steel. Capt. Sampson, Chief of the Ordnance Bureau, declares that the recent test of the Bethlehem 18-in. Harveyized armor for the "Massachusetts" conclusively proves that 13-in., and not 12-in., guns are needed on battleships. At that test a 12-in. Holtzer projectile penetrated only 11 ins. into the armor. He claims a 13-in. half-ton shell would have gone through, and he proposes to test the same plate with the 13-in. gun.

The Cataract General Electric Company, which has a provisional contract with the state of New York for towing boats on the Erie Canal by electric power, thus outlines its present plans, through its vice-president, Mr. F. W. Hawley. As proposed, a line of steel posts, 14 ft. high and 150 ft. apart, would be set along the bank of the canal. These posts would carry two steel cables; an upper one, 1½ ins. in diameter, and a lower one of 1 in. diameter. From the upper cable would be suspended a motor-car, and around the driving-shaft of this motor the lower cable would pass twice, in such manner that the car can move in either direction. The motor-car would be entirely under the control of a motorman stationed upon it, and to the car the tow-line of the canal boat would be attached. The current for operating the motor would be supplied from the dynamo through the upper cable, and return to its source through the lower cable, insuring a complete metallic circuit. In practice, a 7-HP. motor is deemed sufficient to tow one or two heavily loaded boats; and its weight would be very little. Mr. Hawley says that, as soon as the Niagara Falls Power Co. can deliver the current, his company will build an experimental line, two miles long, on both sides of the canal near Tonawanda.

The Argentine Republic, through the Bureau of American Republics, at Washington, D. C., asks from the architects of the world plans for a new building for the use of the Argentine Congress. Three prizes of $20,000, $10,000 and $5,000 are offered for the best designs; the architect taking the first prize to be the architect of the building. These prizes, however, are payable in Argentine paper-money, worth 24 cts. on the dollar in gold at this time.

Plans for a revolving steel-turret fort on Romer Shoals, at the outer entrance to New York harbor, have been prepared by the Fortification Board of the War Department. The turret would be armed with the heaviest ordnance and be itself capable of resisting shot from the heaviest guns afloat. The estimated cost is $5,000,000, which the next Congress will be asked to appropriate. This fort would absolutely command all entrance to the harbor and would prevent an enemy from shelling the city under cover of Coney Island.

A four-year course in sanitary science has been established at Purdue University, to begin with the year 1895-6. The degree of B.S. will be given.

Work is progressing rapidly on the grounds and buildings of the Cotton States & International Exhibition at Atlanta, Ga., about 1,800 men being employed. The Electricity Building is nearly completed, and work is well advanced on the Machinery, Government, Fine Arts, Manufactures and Forestry buildings.

An air reheater for compressed air work has recently been put on the market by the Ingersoll-Sergeant Drill Co., of New York city. The reheater is a conical chamber composed of two cast iron shells bolted together, and having an annular chamber at the top and bottom. The outside of the heater is covered with non-conducting material, and jacketed with sheet iron. The air enters the upper chamber and passes downward over the heating surface, the increasing size of the heater allowing the air to expand as it descends without increasing its velocity. The outlet is taken from the lower chamber, the heater being placed near the work, so that the outlet pipe may be as short as possible. Gas, oil, coke or coal can be used for fuel, and for either of the latter materials a shaking and dumping grate, ashpit and smoke pipe damper are provided. The heater is 42 ins. diameter at the base and 54 ins. high, with a grate 19 ins. diameter, and the weight is about 2,300 lbs. The heater has a capacity for heating 340 cu. ft. of free air per minute, at 46 lbs. pressure, to a temperature of 360° F., giving a gain in efficiency of 35% in work done, as compared with the same volume of air used cold.

The pumping of coal from the mines to tidewater is again being discussed. Mr. W. C. Andrews, President of the New York Steam Heating Company, is said to be about building an experimental line in Pennsylvania with this end in view. His plan is to crush the coal into a fine powder at the mines and then dilute it with sufficient water and force it through steel pipes to the seaboard by means of pumping stations along the line. The scheme was discussed in our issue of Feb. 22, 1894.

TWELVE-WHEEL FREIGHT LOCOMOTIVE; SOUTHERN PACIFIC RAILWAY.

One of the most striking features in the development of modern railway equipment is the rapid increase in the size and weight of freight engines, which has reached its highest point in the enormous freight engines which are becoming common on mountain divisions and on roads having heavy traffic and steep grades. Among the heaviest examples of this type of engine ever built is that shown in the accompanying cut, Fig. 1, which represents an engine built for the Central Pacific Division of the Southern Pacific Co.'s system. It is one of two engines built for that company by the Schenectady Locomotive Works, of Schenectady, N. Y., and the two are the heaviest locomotives which these works have ever turned out. Before describing the details of this engine, it may be interesting to compare its weight with that of some other heavy engines for similar service, and it will be seen that while in total weight it ranks the fourth on the list, yet in the weight per driving wheel it ranks second, its weight of 18,313 lbs. per driving wheel being exceeded only by the 19,500 lbs. of the decapod engines of the St. Clair tunnel. The comparative weights of twelve of the heaviest engines in service are shown in Table I.

The engine is of the twelve-wheel or mastodon type, having eight driving wheels and a four-wheel leading truck. The second pair of driving wheels are the main drivers, and the two middle pair of driving wheels have blind tires. Richardson balanced slide valves are used, and the piston rods and valve stems have Jerome metallic packing. The bridges between the steam ports are 1¼ ins. wide. The main crankpins are 6 ins. diam. and 6 ins. long for the main rods and 6½ × 5¼ ins. for the side rods; the intermediate crankpin is 5½ × 4½ ins., and the front and back crankpins are 5 × 3¾ ins. The boiler is of steel, having butt-jointed horizintal seams, sextuple riveted, with inside and outside welt strips. The circumferential joints are double riveted. The firebox is of Schoenberger steel, with the crown stayed by bars ⅞ × 7 ins., welded at the ends. It is above the frames and supported by links to allow for expansion. The grate is of the rocking finger-bar pattern, and the ashpan is sectional. The engine is designed for burning bituminous coal for fuel. The feed is supplied by two No. 10 Monitor injectors made by Nathan & Co., of New York, N. Y., and the throttle valve is a double-poppet balanced valve, with openings 4⅜ ins. and 5 ins. diameter. The Westinghouse-American combined air-brake is fitted for braking the driving wheels, tender and train, and the engine is also fitted with the Sweeny brake gear, the Lechatelier water-brake and the Leach sand jet apparatus (Eng. News, Feb. 13, 1892). The tender is carried on 33-in. Canda chilled plate wheels, with the Southern Pacific standard truck, and has great fuel capacity, an iron screen preventing the coal from spilling when the tender is loaded full. The engine is very plain and simple in appearance, and is an example of the modern tendency towards the strictest simplicity of finish, to the elimination of all the moldings and ornamental work formerly used in such profusion. The engine is not the less handsome, however, and, in fact, is imposing enough by its mere size and appearance of ponderous strength. A noticeable feature, however, is the extreme shortness of the pilot, which projects but little beyond the line of the bumper beam. The total length of engine and tender is 59 ft. 6½ ins. Fig. 2 is an outline diagram showing the general design and dimensions of the engine and tender.

The leading dimensions and particulars of the engine are given (in our standard form) in Table II., for which, as well as for the photograph from which our cut is made, we are indebted to the Schenectady Locomotive Works, of Schenectady, N. Y. For the outline diagram, indicator cards and details of tests we are indebted to Mr. H. J. Small, Superintendent of Motive Power and Machinery, Southern Pacific Co.

These engines are intended for use between Sacramento and Truckee, crossing the Sierra Nevada mountains; and between Los Angeles and Bakersfield, crossing the Tehachapi mountains. Both divisions are laid with 76-lb. rails, and profiles of these divisions are shown in Figs. 3 and 4. On Feb. 23, 1895, the indicator cards shown in Fig. 5 were taken from one of these engines (No. 2011) during a run between Sacramento and Blue Canyon, on the Sacramento Division. The engine was hauling a freight train composed of two loaded box cars and 29 empty stock cars, the total weight of train, exclusive of the engine and tender being 402½ tons

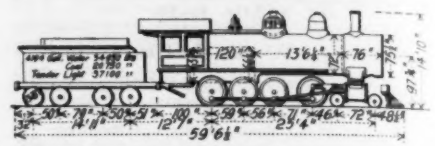


Fig. 2. Diagram of Twelve-Wheel Locomotive and Tender.

The maximum grade is 116 ft. per mile (2.2%), as shown on the profile, Fig. 3. The engine was working with a very light throttle for all the cards, but it must be remembered that the engine has a double-beat throttle valve, which gives a greater area of opening than an ordinary throttle valve. The engine was handled by the regular crew, who were left to handle it in their own way, the purpose being to get the results under actual service conditions. Two firemen were employed. In starting on the grades the engine is said to have showed a tendency to slip the driving wheels with such a heavy train when the throttle was wide open.

FIG. 1. TWELVE-WHEEL LOCOMOTIVE, SOUTHERN PACIFIC RAILWAY; Schenectady Locomotive Works, Builders.

TABLE I.—Comparative Weights and Dimensions of Heavy Locomotives.

Railway.	Type of engine.	No. of wheels. Driving.	No. of wheels. Truck.	Weight. On drivers, lbs.	Weight. Total, lbs.	Weight. Per driving wheel, lbs.	Cylinders, ins.	Driving wheels, ins.	Described in Eng. News.
Mexican Central	Double truck	12	4	200,000	230,000	16,667	13 & 28 × 24	48	March 26, 1892
St. Clair Tunnel	Decapod, tank	10	0	195,000	195,000	19,500	22 × 28	50	Oct. 4, 1890
New York, Lake Erie & Western.	Decapod	10	2	170,000	192,000	17,000	16 & 27 × 28	50	June 15, 1893
Southern Pacific	Twelve-wheel	8	4	146,500	173,500	18,313	22 × 26	51	May 9, 1895
Duluth & Iron Range	"	8	4	139,000	169,000	17,375	22 × 26	54	May 25, 1893
Central Brazil	"	8	4	138,600	168,600	17,325	21 × 26	54	Sept. 20, 1894
Iron Range & Huron Bay	"	8	4	136,000	162,000	17,000	20 × 26	56	July 7, 1892
Great Northern	"	8	4	136,000	156,000	17,000	20 × 26	55	May 5, 1892
Delaware, Susq. & Schuylkill	Mogul	6	2	.....	151,000	.....	22 × 26	62	June 7, 1894
Burlington & Missouri River	Decapod	10	0	150,300	150,300	15,030	22 × 28	40	Feb. 6, 1892
Cornwall & Lebanon	Consolidation	8	2	135,000	150,000	16,875	14 & 28 × 24	50	June 23, 1892
Mohawk & Malone	"	8	2	132,000	149,000	16,500	22 & 32 × 28	51	Oct. 12, 1893

The conditions under which the cards were taken are shown in Table III.

In March 1, 1895, tests were made of the comparative performance of three twelve-wheel engines (two simple and one compound engine of the two-cylinder type), under the direction of Mr. Howard Stillman, Engineer of Tests. The engines were all built by the Schenectady Locomotive Works, and their general dimensions were as follows: It will be seen that the first two engines are nearly identical, except as to their cylinders:

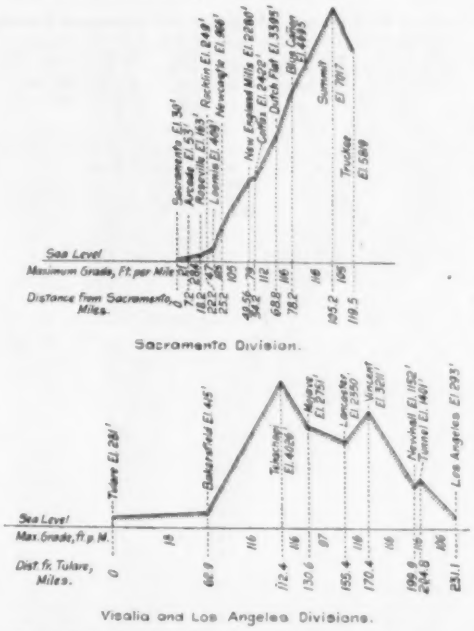
	Engine.		
	No. 375, So. Pac.	No. 367, So. Pac.	No. 2,011, Cen. Pac.
Simple or compound....	Simple	Compound	Simple
Driving wheels.....	51 ins.	51 ins.	51 ins.
Weight on drivers, lbs..	109,700	109,750	146,500
" total, lbs.....	133,000	139,000	173,500
Cylinders, ins.....	20 × 26	20 & 29 × 26	22 × 26
Grate area, sq. ft.....	30.82	30.82	34.58
Heating surface, sq. ft..	1,884	1,884	2,354.78

TABLE II.—Dimensions of Heavy Freight Locomotive; Southern Pacific Railway.

General Description.—	
Type of engine	Mastodon or Twelve-wheel
Class of traffic	Freight
Gage	4 ft. 8½ ins.
Fuel	Bituminous coal
No. driving wheels	8
No. truck wheels	4
Simple or compound	Simple
Running Gear.—	
Driving wheels, diameter	4 ft. 3 ins.
Truck " "	2 " 0 "
Tender " "	2 " 9 "
Engine truck	Swing bolster
Journals, driving axles	8½ × 9 ins.
" truck axles	5 × 9 "
" tender axles	4¼ × 8 "
Wheel Base.—	
Driving	15 ft. 6 ins.
Truck	6 " 0 "
Total engine	25 " 4 "
" tender	14 " 11 "
" engine and tender	52 " 9 "
C. of truck pin to c. of leading driver	6 " 10 "
Wheels having blind tires	2d and 3d pairs
Weight in Working Order.—	
On driving wheels	146,500 lbs.
On truck "	27,000 "
Percentage of weight on drivers	84.44%
Engine, total	173,500 lbs.
Tender, "	92,833 "
Engine and tender, loaded	266,333 "
Tender, empty	35,500 "
Of full coal capacity	24,000 "
" " water capacity of tank	33,333 "
Cylinders	22 × 26 ins.
Cylin. area per sq. in. of tube opening	0.85 sq. "
Distance center to center	7 ft. 2 "
" " " valve face	3 "
Piston rod, diameter	4 "
Form of crosshead and guides	Laird
Connecting rod, length between centers	8 ft. 5½ ins.
Valve Gear.—	
Type	Stephenson
Ports, steam	1¼ × 18 ins.
" exhaust	3 × 18 "
Slide valves, lap, outside	¾ in.; inside, 1-32 in.
" " maximum travel	5½ ins.
" " lead at full stroke	1-16 in.
Boiler.—	
Type	Straight top
Diameter of barrel inside	5 ft. 10⅝ ins.
Thickness of barrel plates	11-16 in.
" " smokebox tube plate	9-16 "
Height from rail to center line	8 ft. 1 "
Lgth. of s'kebox, from tube sheet, inside	6 ft. 3⅜ ins.
Working steam pressure	180 lbs.
Firebox.—	
Type	Wide, shallow; above frames
Length inside	10 ft. 0⅛ in.
Width "	3 " 5⅜ ins.
Depth at front	5 " 6½ "
" " back	5 " 3 "
Thickness of side and back plates	5-16 in.
" " crown sheet	⅜ "
" " tube "	9-16 "
Grate area	34.58 sq. ft.
Staybolts, diam.	⅞ and 1 in.; pitch, about 3¾ ins.
Water space, width, front, 4 ins.; sides & back,	3½ "
Tubes.—	
Material	Charcoal iron; Number, 274
Pitch	3 ins. on back tube sheet, spread out on front
Diameter	inside, 2 1-32 ins.; outside, 2¼ ins.
Thickness	No. 12 W. G.
Length between tube plates	13 ft. 4⅞ ins.
Total fire area of tube openings	6.16 sq. ft.
Heating Surface.*—	
Ratio to grate area (with exterior tube area)	68.01
Ratio of exter. tube area to firebox heat'g surf.	12.6
Tubes, exterior	2,161.70 sq. ft.
" interior	1,952.96 " "
Firebox	184.90 " "
Total with exterior tube area	2,346.60 " "
Total with interior tube area	2,137.86 " "
Miscellaneous.—	
Exhaust nozzles, diameter	5¼, 5½ and 5¾ ins.
" " area	25.97 sq. ins.
Smokestack, smallest diameter	1 ft. 4 "
" height from rail to top	14 " 8½ "
Capacity of tank	4,000 gallons
Capacity of coal space	24,000 lbs.
Brake fittings—Westinghouse-American combined on drivers, tender and train.	

* There is a little difference between the above figures, given by the builders, and those given by Mr. Small, the Superintendent of Motive Power, the latter figures being as follows:

Heating Surface.—	
Tubes, exterior	2,170.52 sq. ft.
Firebox	184.26 " "
Total with exterior tube area	2,354.78 " "
Per square foot of grate area	68.1 " "
Per square in of cylinder area	3.1 " "
Cylinder area per sq. in. of tube area	0.85 " in.



Figs. 3 and 4. Profiles of Sacramento and Los Angeles Divisions; Southern Pacific Ry.

Table IV. gives a comparison of the average performance of the new engine in March, 1895, with performances recorded in 1891 of the two other twelve-wheel engines above mentioned, all working in freight service. All train weights given are exclusive of the weights of engine and tender, and the tests of engine No. 2011 were made under ordinary service conditions, except for the careful measurements of coal and water and of the weight of train hauled. From this table it will be seen that this engine, on the Sacramento Division, with a maximum grade of 2.2%, hauled a train-load of 405.85 tons, which was from 41 to 50% more than the load hauled by the heaviest engines previously in use, while the new engine showed a decrease in fuel consumption of 12.65% compared with that of the other twelve-wheel simple engine, and 4.2% compared with that of the twelve-wheel compound engine. The new engine used Carbon Hill and Castle Gate coal, while the others used Carbon Hill and Rocky Mountain coal.

In Table V. is given an interesting comparison of the hauling capacity of eleven different locomotives of the Southern Pacific Ry., at a speed of 12 miles per hour. The mean effective pressure is taken as 70% of the boiler pressure, and the adhesion at 1-5 and 1-4 the weight on the driving wheels, the tractive power being taken when it is not greater than the adhesion. The track and rolling stock are supposed to be in good ordinary condition.

TABLE III.—Conditions When Indicator Cards were Taken.

No. of card	1	2	3	4	5	6	7	8
Cut-off, ins	23½	22	15	15	13	10	6	6
Revolutions per min	24	60	48	60	84	152	140	148
Piston speed, ft. per min	208	520	416	520	728	1,317	1,213	1,283
Velocity of train, miles per hour	3.64	9.10	7.28	9.10	12.74	23.06	21.24	22.45
Boiler pressure, lbs	172	180	172	168	175	170	175	175
M. E. P. in cylinder (both ends)	156.12	130.09	126.30	122.87	97.42	48.66	40.36	41.19
I. HP. of engine	367.88	766.36	595.22	723.82	803.46	726.19	554.77	598.53
Steam used per HP. per hour, lbs	32.633	31.989	23.988	24.352	22.529	15.82	18.33	17.746
Total tractive power of engine, lbs	37,888	31,568	30,649	29,816	23,641	11,808	9,794	9,995
M. E. P. on cross-head, lbs	58,365	48,634	47,217	45,935	36,420	18,192	15,088	15,399

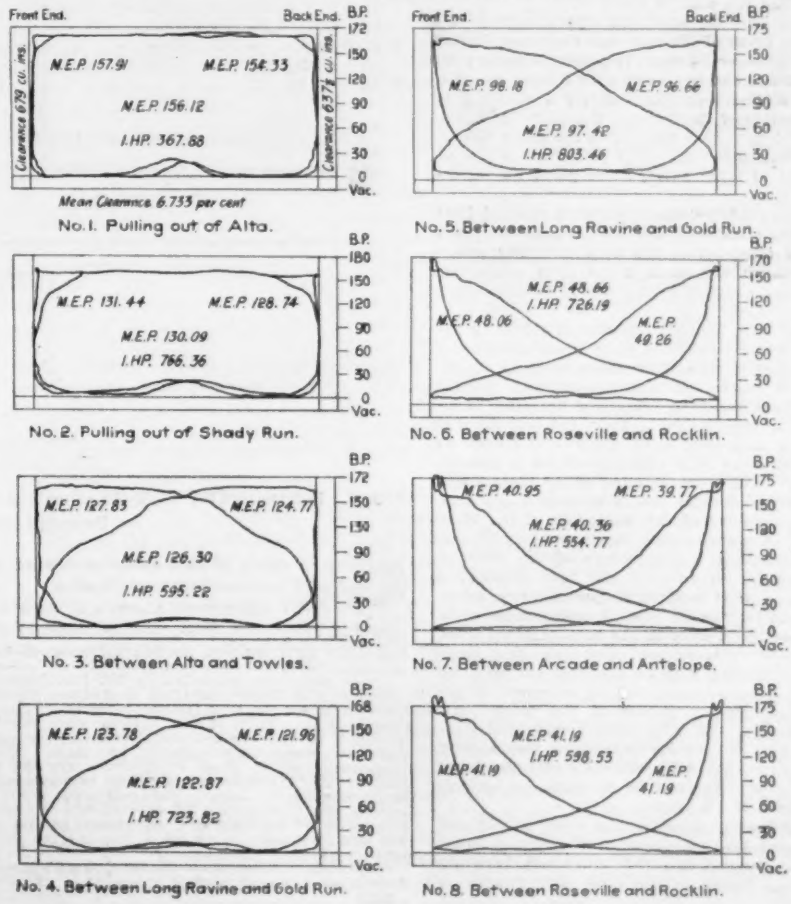


FIG. 5. INDICATOR DIAGRAMS FROM TWELVE-WHEEL LOCOMOTIVE; SOUTHERN PACIFIC RY.

AN INSTANCE OF THE VALUE OF STATE TOPOGRAPHICAL SURVEYS.

In an address recently delivered by Mr. R. A. Cairns, C. E., before the students of the Rennselaer Polytechnic Institute, reference was made to the value of the state map of Connecticut, and the use which was made of it in planning the new water supply system of Waterbury, Conn. We reprint the following extract from Mr. Cairn's address, as published in the "Polytechnic":

The subject of an additional water supply for Water-

TABLE IV.—Comparative Performance of Simple and Compound Twelve-Wheel Locomotives.

	Round trips between Sacramento and Truckee.					Single trips from Sacramento to Truckee.				
	No. 375; So. Pacific; simple.	No. 367; So. Pacific; compound.	No. 2,011; Cen. Pacific; simple.	Difference of No. 2,011 over No. 375.	Difference of No. 2,011 over No. 367.	No. 375; So. Pacific; simple.	No. 367; So. Pacific; compound.	No. 2,011; Cen. Pac.; simple.	Difference. No. 2,011 over No. 375.	Difference. No. 2,011 over No. 367.
				Per cent.					Per cent.	
Number of trips	13	18	3	....	....	13	18	3	....	....
Distance, miles per trip	239	239	239	....	....	119.5	119.5	119.5	....	....
Number of cars in train	11 5-26	10 17-18	15⅔	+ 40.04	+ 43.14	11 3-13	10 8-9	15	+ 33.57	+ 37.76
Weight of train, tons per trip	285.97	270.40	405.82	+ 41.91	+ 50.08	277.07	270.70	404.17	+ 45.87	+ 49.30
Total car-miles	2,675	2,616	3,744	+ 39.97	+ 43.12	1,342	1,305	1,673	+ 24.66	+ 28.20
Total ton-miles	68,347	64,626	96,991	+ 41.91	+ 50.08	33,109	32,348	48,298	+ 45.88	+ 49.31
Total coal used, lbs.	26,574	22,910	32,940	+ 23.96	+ 43.78	20,988	17,462	25,773	+ 22.80	+ 47.59
Total water used, lbs.	149,178	127,230	201,768	+ 35.25	+ 58.58	115,878	97,731	158,150	+ 36.47	+ 61.82
Coal used per 100 car-miles, lbs.	993.429	875.868	879.861	+ 11.43	— 0.45	1,563.891	1,342.012	1,540.526	+ 1.49	— 14.79
" " " 100 ton-miles, lbs.	38.881	35.451	33.962	+ 12.65	+ 4.20	63.392	53.983	53.362	+ 15.79	+ 1.15
Water used, per 100 car-miles, lbs.	5,576.836	4,864.053	5,393.548	+ 3.28	— 10.88	8,634.246	7,510.678	9,458.830	— 9.55	— 25.94
" " " 100 ton-miles, lbs.	218.266	196.872	208.187	+ 4.61	— 5.75	349.986	302.119	327.643	+ 6.38	— 8.45
Water evaporated per lb. of coal, lbs.	5.614	5.553	6.13	+ 9.19	+ 10.39	5.52	5.60	6.14	+ 11.23	+ 9.64

TABLE V.—Hauling Capacity of Locomotives; Southern Pacific Railway.

Curves, in degrees.	Max. grade, ft. per mile.		Number and type of engine.										
			No. 1,990. Schen. 12-wheel compound.	No. 2,000. Schen. 12-wheel compound.	No. 1,955. Schen. 12-wheel simple.	No. 1,910. S. P. Co. consol. simple.	No. 1,770. S. P. Co. 10-wheel simple.	No. 1,750. Schen. 10-wheel simple.	No. 1,800. Cooke 10-wheel simple.	No. 1,787. Schen. 10-wheel simple.	No. 1,790. Schen. 10-wheel compound.	No. 2,011. Schen. 12-wheel simple.	No. 1,819. Cooke 10-wheel simple.
		Cylinders, ins.	20 & 29×26	20&30×26	20 × 26	19 × 30	18 × 30	18 × 24	19 × 24	19 × 24	20&29×26	22 × 26	20 × 26
		Driving wheels, diam., ins.	51	51	51	51	57	54	63	69	69	51	63
		Weight of engine loaded, lbs.	140,800	141,000	133,000	114,850	105,100	106,200	130,750	127,000	132,150	173,500	142,350
		" " tender " "	82,800	82,800	71,800	69,400	69,400	68,300	80,450	82,800	82,800	92,800	88,800
		Total wt. of eng. and tender loaded.	223,600	223,800	204,800	184,250	174,500	174,500	211,200	209,800	214,950	266,300	231,150
		Weight on drivers, lbs.	120,200	117,750	109,700	101,200	78,700	87,500	104,900	101,500	100,050	146,500	112,050
		Adhesion at 1-5 weight, lbs.	24,040	23,550	21,940	20,240	15,740	17,500	20,980	20,300	20,000	29,300	22,410
		" " ¼ " sanded rail.	30,050	29,437	27,425	25,300	19,675	21,875	26,225	25,375	25,000	36,625	28,012
		Tractive power, lbs.	23,058	23,277	22,839	22,297	17,308	16,128	15,403	15,821	17,043	31,000	20,830
		Boiler pressure, lbs.	180	180	160	150	145	160	160	180	180	180	180
		Mean effective pressure, lbs.	100 & 60	100 & 57	112	105	101.5	112	112	126	100 & 60	126	126
		Between what points.	Adhesion at	Pounds of loaded cars, exclusive of engine and tender.									
0	26.	Sacramento to Rocklin.	1-5	2,375,800	2,400,200	2,268,500	2,097,400	1,599,900	1,643,600	1,525,200	1,573,700	1,706,300	3,036,700	2,449,400
		" " "	1-4	2,375,800	2,400,200	2,369,900	2,329,300	1,776,600	1,643,600	1,525,200	1,573,700	1,706,300	3,238,500	2,449,400
10	105.	Rocklin to Colfax.	1-5	637,500	645,400	614,500	571,600	413,300	427,800	364,000	381,000	421,500	827,900	776,800
		" " "	1-4	637,500	645,400	648,100	648,400	471,800	427,800	364,000	381,000	421,500	894,700	776,800
10	116.	Colfax to Summit.	1-5	577,200	584,600	557,100	518,600	372,100	385,600	323,700	339,600	376,900	751,200	722,300
		" " "	1-4	577,200	584,600	589,300	590,100	426,600	385,600	323,700	339,600	376,900	813,400	722,300
10	105.	Truckee to Summit.	1-5	637,500	645,400	614,500	571,600	413,300	427,800	364,000	381,000	421,500	827,900	776,800
		" " "	1-4	637,500	645,400	648,100	648,400	471,800	427,800	364,000	381,000	421,500	894,700	776,800
10	116.	Bakersfield to Los Angeles.	1-5	577,200	584,600	557,100	518,600	372,100	385,600	323,700	339,600	376,900	751,200	722,300
		" " " "	1-4	577,200	584,600	589,300	590,100	426,600	385,600	323,700	339,600	376,900	813,400	722,300

bury had been agitated for more than ten years previous to the year 1893, and, while there was only one opinion as to the need of an increase of the supply, there developed a great variety of opinions as to the proper source from which it should be obtained. A careful report was made by Mr. Rudolph Hering on two sources, known respectively as the Eastern or Mad River source and the Western or Hop Brook source.

Various difficulties arose, however, in the way of carrying out the recommendations of the special committee, which accorded with the views of this eminent engineer. The principal one was the opposition that has been made upon the survey, may be easily effected within the next 20 years.

About this time my attention was attracted to a stream lying north of the city, and somewhat farther away than the other sources. It presented many good features and few bad ones, and after a brief examination of the state topographical survey I ventured to call the attention of the Common Council to it. It was eagerly seized upon as a way out of the many difficulties which surrounded the other plans, and I was at once directed to make surveys and plans for its development.

Examination confirmed the impressions received from a study of the state map, and for the past two years the work of construction has been diligently prosecuted. Although the work is far from completed, water has been supplied to the city from this source since Jan. 17, 1895.

I wish to add my testimony to that of others on the value to the general public of state topographical surveys. The special committee above referred to expended about $6,000 on its investigations. Several thousand dollars had been previously expended in investigating the same subject. First and last the city of Waterbury must have spent upwards of $10,000 on surveys which were only explorations for a suitable water supply. The accurate maps of the State Topographical Survey enabled me to determine the area and general character of the watershed of the West Branch, and to approximately locate a reservoir and pipe line, all without going outside of the office or spending a dollar in surveys, and that although I had never so much as seen the stream under consideration. Nor did the careful surveys subsequently made disclose any material error in the data gathered from the state map. It is evident, therefore, that these topographical surveys may be justified not only by their general scientific value, but on the score of the most practical economy in dollars and cents. My recollection is that the topographical survey of Connecticut, an area of 5,004 square miles of very uneven country, only cost about $50,000, with perhaps $5,000 more for printing. The cost to the state did not exceed $30,000.

In the investigation of matters of water supply and sewerage a saving to the people of Connecticut equal to this entire expenditure, both state and national, which was manifested of the large mill owners on Mad River.

THE MEASUREMENT OF LIVE-LOAD STRAINS IN BRIDGES.*

By J. Jay Hankenson, B. C. E., and Wm. H. Ledger, B. E.

(With inset.)

Accurate knowledge of the stresses in bridge members has long been sought by the engineering profession, and during the last few years there has been a general call by the bridge engineers of this country for experiments that would give definite data concerning the stresses produced in bridge members by trains of high speed as compared with the computed stresses from static loading.

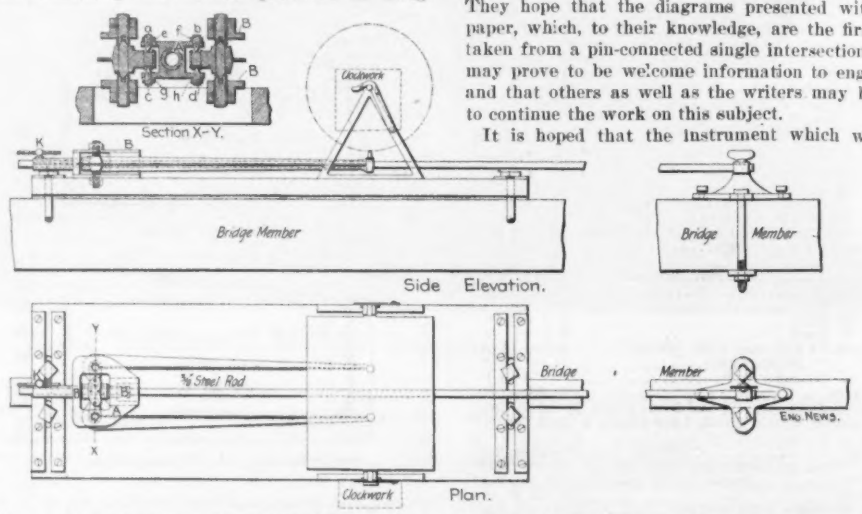


FIG. 1. INSTRUMENT FOR MEASURING ELONGATION OF BRIDGE MEMBERS UNDER STRAIN.
Designed by J. Jay Hankenson, C. E.

The writers commenced a series of such experiments in November, 1893, with the hope of obtaining some data bearing on the behavior of tension bars while subjected to the various loading of ordinary railway traffic.

The success of these experiments has been rather indecisive, owing principally to the multitude of unforeseen conditions and disturbing elements which modify live-load stresses, and to lack of time and means to ferret out the truth by a more extended series of tests.

In view of these facts, the writers have refrained from making any statements or drawing conclusions which are not fully warranted by their diagrams. They hope that the diagrams presented with this paper, which, to their knowledge, are the first ever taken from a pin-connected single intersection truss, may prove to be welcome information to engineers, and that others as well as the writers may be able to continue the work on this subject.

It is hoped that the instrument which was devised for the purpose, or some modification of it, may be found of a form convenient for use in more comprehensive investigations. Its simplicity of construction and its rigidity are the characteristics which recommend it for use where there is so much rapid vibration as in the members of certain classes of bridges.

The instrument as at present constructed can only be applied to tension members, but by additional attachments it can be used on compression members as well. The principal difference between this and apparatus previously devised is that the elongation of nearly the whole bar is measured, instead of a meter or less, thus rendering the percentage of liability of error from slipping at the point of attachment to a minimum, and reducing the necessary

* This paper was presented by Mr. Hankenson, as a thesis in the College of Civil Engineering in Cornell University, for the Post Graduate degree of Master of Engineering. Both of the writers were closely associated in the work from its conception and all expenses were borne jointly by them. The instruments used in these experiments are the invention of Mr. Hankenson and their construction was superintended by him. The computed static load curves, the descriptions of experiments and general discussion of the diagrams, as offered in this paper, are also his work. In all other respects the field and office work were borne equally.

(The diagrams shown on the inset sheet are selected from a much larger number presented by the writers. —Ed.)

multiplication by the instrument. Thus no compound levers are used, the multiplication being obtained by a single lever multiplying 25 times. A ⅜-in. steel rod is attached to a bracket at one end of the bar whose elongation is to be measured by means of a friction clutch, the bracket itself being bolted to the bar, and held in place by a conical steel point. The bracket is prevented from tilting forwards or backwards by thumb-screws, as shown in Fig. 1. The steel bar and wooden guides are used in lengths of 6 ft., for convenience of transportation, the bars being coupled together at the bridge by means of sleeve nuts, and the guides by a wrought iron plate bolted to the end of each length.

The instrument itself, shown in Fig. 1, consists of two bell-crank levers, each multiplying 25 times, and mounted in conical bearings of hardened steel. The ⅜-in. steel rod passes between these levers and into a brass pipe, to which it is engaged by a friction clutch (K). To this pipe is fixed the casting A. Through this casting are hardened conical steel points (a, b, c, d) which fit into the V-shaped grooves, also of hardened steel, in the short arms of the levers. These steel points can be brought into adjustment and then clamped by means of the check nuts (e, f, g, h). The whole movement of the casting A is limited by the cast frame B, which serves to keep the whole rigid, and acts as a guide to the brass tubing. The levers are made as light and rigid as possible, and are cast in aluminum bronze. All other parts excepting the bearings are made of cast brass.

The movement of the levers is recorded on the revolving drum. This is constructed of wood, and is very light. The ends are made of three layers, ⅛ in. thick, glued together with the grain in different directions, thus preventing any shrinking or warping. The shell is ⅛ in. basswood. The cylinder is 7¼ ins. in diameter, and is driven by clockwork from the side. The clock is provided with two strong springs and a fan governor. It engages with the axis of the cylinder through cog wheels, enabling the cylinder to be removed in order to change the diagram paper.

The use of two levers may seem at first sight to be unnecessary. The objects which the writers had in view were the following: First, any sudden jar to which the instrument might be subjected laterally would cause each lever to move in the same direction, and thus by measuring the total distance between the curves, and subtracting the corresponding initial distance, any error from this source is eliminated. By the same means any error common to both curves, such as the shifting of paper or cylinder, is also eliminated. On using the instrument, however, it was found that this precaution was unnecessary, as, when properly adjusted, it is sufficiently rigid to withstand the lateral vibration. The second reason for using double levers was that one curve might be a check upon the other. If the two correspond, it gives more confidence in the accuracy of the results, and it may be noted that the curves do practically correspond in nearly every case.

The speed of the trains was obtained by means of a stop-watch and electric sounder, placed in a watchman's shanty at the bridge. The sounder was connected to two plug switches placed 285 ft. apart. These switches, shown in Fig. 3, were made of hard-rubber tubing, ⅝ in. in diameter, and about 7 ins. long. This tubing is placed in a vertical position. A string passing over the rail to a brass plug placed in the top of the tubing is kept tight by a weight suspended from the lower end of the plug by another piece of string. As the first wheel of the engine passes over the string it cuts it, and the weight then pulls the brass plug through the tube, and, by contact

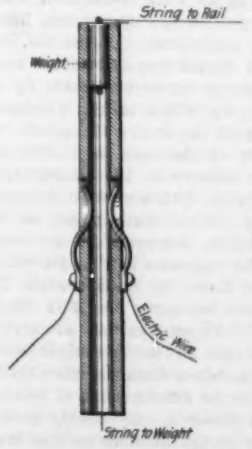


Fig. 3. Vertical Section of Switch for Obtaining Speed of Train.

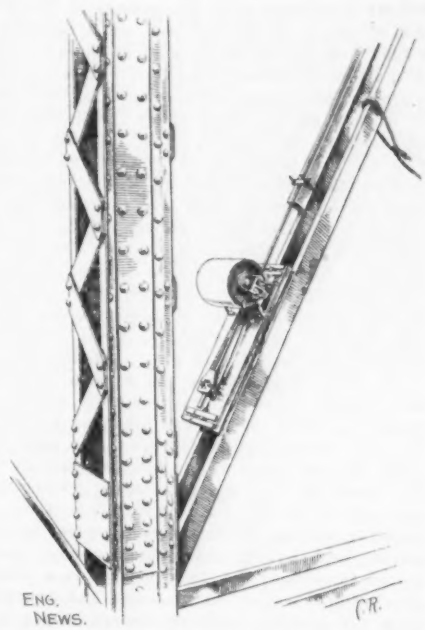


Fig. 3. Perspective View of Instrument Attached to First Main Diagonal of a Single Intersection Pratt Truss.

between the plug and two brass springs, placed on oposite sides of the tube, and bending inwards through holes in its side completes the circuit through the sounder. On the plug passing the springs, the circuit is again broken, thus allowing the sounder to reply to the switch at the next point. This method caused some trouble in wet, freezing weather, but as a portion of this series of experiments was carried on during the night as well as in day light, sight signals could not be used. In other experiments, simple drop semaphores, operated by a string, in the same manner as the switches, were used, and were found to be very satisfactory.

The excessive vibration to which an instrument of this kind would be subjected was kept in constant view in its design and manufacture, and the result is that there is no lost motion when it is in proper adjustment. But the variations of stress take place so quickly in certain members of a bridge, when a train passes over it at a high speed, that the levers of the instrument move with extreme rapidity, and the writers have reason to believe that the momentum of the levers, when moving very rapidly, may carry them beyond the multiplied elongation which they should record, but how far it is impossible to determine. There are many instances in nearly every diagram where the levers have been suddenly stopped during their greatest vibration by some change of stress in the eye-bar, showing that the maximum stress recorded is not far from the true value. It was found that no appreciable movement of the levers could be caused by shaking or by heavily jarring the member or instrument by blows from a hammer. All this tends to show that the instrument is very sensitive to changes of stress in the eye-bar, and to that alone.

During the months of January and February, 1894, the authors took 9 diagrams from a single-track bridge on the Lehigh Valley R. R., over Inlet Creek, about 2½ miles south of the station at Ithaca, N. Y. A diagram of this bridge is shown in Fig. 4. It is of the single-intersection Pratt truss type, with a span of 115 ft. It is a comparatively new and well-built structure. The bars are in good adjustment, and closely packed. The floor system consists of built floor beams and stringers, the stringers being riveted to the floor beams with their upper flanges at nearly the same level. The lower lateral system consists of round rods passing through the webs of the stringers and floor beams. The latter are suspended from the lower chord pins by single square bar hangers. The bridge is located on a tangent, with a curve about ¼ mile north, and another about one mile south of it. The bridge, as a whole, was found to be rigid and free from excessive lateral or vertical vibration under trains, some of which crossed at speeds as high as 60 miles per hour.

Diagrams were taken from both of the bars of the hip-vertical and main-diagonal at the north end of the west truss, and from one of the bars of its lower chord near the center of the bridge. As the diagrams taken from the different bars of the same member of this bridge did not show any appreciable difference, we have not designated on the drawings from which bar they were taken. Only one of the bars composing the lower chord was tested, as the longitudinal vibrations in the bar were so excessive as to preclude any calculation from the diagrams, hence they were taken only as types to show the character of the stresses in the lower chord from different classes of traffic.

Longitudinal vibration, or the rapid variation of stress, is found to be much more excessive in the lower chord near the center of the span than in any other tension members of the truss; while the hip-vertical, which is commonly conceded to receive a more variable stress than other members, shows a stress far less variable than that in the lower chord.

The great difference between the longitudinal vibrations in the lower chord and hip-vertical is very apparent from the diagrams, when it is remembered that the instrument centers were spaced 1½ times as far apart on the hip-vertical as on the lower chord, which results in giving diagrams from the lower chord on a smaller scale than those from the hip-vertical.

The main diagonal is subjected to a less amount of longitudinal vibration than any other of the tension members. The reason for this great amount of longitudinal vibration in the lower chord is that it receives the stresses of all the members on their way to the abutments, consequently every variation of the stresses in the web members caused by the moving train and shocks from its concentrated truck loads, must cause a variation in the stress of the lower chord.

The above tends to show that the metal of the lower chord is subjected to a much more fatiguing stress than that of any other member of the truss.

The hip-vertical diagrams were taken with instrument centers spaced 18 ft. apart. Assuming the modulus of elasticity to be 28,000,000 lbs. per sq. in., and taking the diagram from one lever arm of the instrument, which multiplies the elongation of the eye-bar 25 times, we find that we have a stress of 5,185 lbs. per sq. in. of bar for an ordinate of 1 in. on the diagram. The diagrams from the main diagonal were taken with instrument centers 23 ft. 6 ins., whence we obtain a stress of 3,972 lbs. per sq. in. of bar for an ordinate of 1 in. on the diagram. Those from the lower chord were taken with 12 ft. between instrument centers, which would give a stress of 7,778 lbs. per sq. in. of bar per vertical inch of diagram. In tracing the diagrams selected from those taken from the bridge, they have been placed so that the portion to the right hand was the first recorded, therefore they read from right to left. The curves traced by both the levers have been reproduced, but only one has been graduated into thousands of pounds per square inch. As before stated, when the instrument was designed, it was thought that it would be affected by lateral vibration and shifting of paper or cylinder, and therefore two levers were used; but the instrument was found to be practically free from these sources of error; hence in the discussion, only one of the curves, referred to a straight line as its abscissa, has been used. In the diagrams taken from the double intersection truss, only one of the curves has been reproduced; all diagrams, however, were taken with both pencils throughout the experiments.

The diagrams in Fig. 5 were taken from the hip-vertical eye-bars during the crossing of the regular passenger trains running on the line; they are light trains, made up of two or three coaches, one baggage car and an engine, all of the ordinary American type. Fig. 6 shows a few typical diagrams selected from those taken from the same member during the passage of freight trains and single

switch engines, some of the trains being mixed freight, while others were coal trains made up of different styles and sizes of coal cars.

Fig. 7 shows diagrams taken from the first main diagonal, with a similar passenger traffic to that by which Fig. 5 was taken, except Nos. 17 and 32, which were produced by a fast express train having a heavier engine and sleeping cars in the rear. Fig. 8 shows diagrams from the same member during the passage of freight trains.

Fig. 9 shows a few typical diagrams taken from the lower chord, near the center of the bridge from both passenger and freight trains.

When the diagrams in Fig. 5 were taken, it was thought that they might throw some light on the mooted question of increased stress in the members of a truss from the impact due to sudden loading by trains at high speeds. An article by Mr. W. H. Booth, M. Am. Soc. C. E., published in "Trans. Am. Soc. C. E.," April, 1889, gives a table of percentages to be added for various lengths of span, the table being computed for a train which would cause a deflection of the bridge of 1-400 of its span, and having a speed of about 61 miles per hour. The span supported by the hip-vertical is 28 ft. 9 ins., and the amount to be added to the static stress for a span of 30 ft. and speed of 61 miles per hour would, from his figures, be 41%. Mr. Booth, however, makes a correction to this table from data derived from the experiments of Mr. Robinson, M. Am. Soc. C. E., on the deflection and vibration of bridges, which gave for the average deflection of bridges 1-2400 of their span. This correction is a constant of 1-2.45, to be multiplied into the percentages given in the above-mentioned table. Applying this to the percentage given for the 30-ft. span, we have $41 \times 1\text{-}2.45 = 16.3\%$.

Referring to the diagrams on Fig. 5, we find speeds ranging from 34 to 55½ miles per hour. The dotted curves show the static unit stresses as given by the wheel loads of the engines from which the diagrams were taken, the stress being assumed to be equally divided between the bars of the member, as was found to be the case in this bridge. It will be seen that the computed curves in some cases agree very closely with the curve recorded by the instrument, and, in fact, in all cases, if the sharp jutting points are thrown out as instrumental vibrations, which, in the writers' opinions, is partly true. Diagram No. 69 may be taken as an exception to the above; it shows an increase of at least 20% over the static load. This diagram was taken from engine No. 504, running at a speed of 55½ miles per hour; it shows an indentation in the maximum tooth-like projection in the diagram, which would tend to show that the lever was checked in its return towards the zero line, and drawn back to nearly the maximum departure. This could only have been caused by the eye-bar being elongated to a greater amount than would have been caused by the static load, and being held in that position for a space of time greater than that required for the vibration of the instrument levers. The same engine in diagram No. 44, running at 52 miles per hour, gives a sharp point, which, if it were taken, would also give an excess of about 20%, and it will be seen that the lever had the same movement towards the zero line as in diagram No. 69, but that it was not checked until after it had passed the static load line. This would tend to show that in this case the same conditions did not exist in the eye-bar as in the case of diagram No. 69. Diagram No. 24 is due to the same engine at a speed of 34 miles per hour, and does not show any increase of stress over the static load.

These diagrams certainly show that under the existing conditions this member was not subjected to any excessive increase of stress above that from static loading. On the whole, they show very clearly the manner in which the bars of the hip-vertical act while carrying the train. First, there is the heaviest load, due to the drivers of the engine, followed by a lighter load from the tender; and it may be noticed that the greater the difference between these two loads, the greater is the vibration in the bar. This second loading continues without diminution until the passage of the first pair of trucks of the first car, when there is a decided reduction of stress and, in cases of long cars, where the distance between centers of truck is greater than two panel lengths, the member may be entirely relieved from stress. Following this depression in the diagram comes the next loading from the rear trucks of the first car and forward trucks of the second; in fact, all the diagrams taken from the hip-vertical show that the train load is a decided wheel or truck loading, which, in many cases of freight trains, falls but little short of the maximum load from the engine drivers. Diagram No. 65 in Fig. 6 shows the stress in the hip-vertical from an engine followed by seven large, loaded coal gondolas and a string of small four-wheel gondolas, also loaded with coal. Diagram No. 68 in the same figure shows the stresses from the same engine on its return trip with a train of loaded box cars. In the two diagrams several of the truck loads reach 80% of the engine load. The sharp indented curve at the head of diagram No. 65, caused by the concentration of wheels near the ends of the car, when compared with the far smoother portion of the diagram formed by the smaller cars, having their wheels nearly equally spaced throughout the train, depicts very vividly the destructive effect on the track and structures from the growing tendency toward longer cars and increased tonnage concentrated on the trucks, which are placed so near the ends of the cars as to practically make additional concentrations with the trucks of adjacent cars.

The computed curves from the wheel load of engines in Fig. 6 agree with the instrumental diagrams quite as closely as those of Fig. 5, if not more closely. That portion of diagram 65 from the small cars shows quite clearly the effect of cumulative vibration, and also how quickly this vibration may be counteracted or reversed by some disturbing element in the train.

In Fig. 7 are given a few typical diagrams taken from the first main diagonal while passenger trains were crossing. The diagonal from which these diagrams were taken was on the north end of the bridge; hence, as would be expected, we find that the curves from trains running south reach a maximum sooner than trains in the opposite direction. On the rising part of the curve we find several indentations, more or less marked, according to the engine that produced the diagram. The points between these indentations, indicating temporary maxima in the stress, are seen to be equal in number to the number of panel points passed by the engine before the maximum stress in the eye-bar is produced. The maxima in the stress curve, caused by the truck loads, are quite marked, although not to so great an extent as in the hip-vertical diagrams. Diagrams No. 17 and 32 show these maxima more decidedly than any of the others, and may be taken as examples to show that each class of engine has its own characteristic diagram. These two were taken from a fast express train having a heavy engine. The difference in the stresses produced by the heavier loading of the long sleeping cars in the rear of the train, and those produced by the shorter and lighter coaches in the forward part, is also quite marked.

Fig. 8 consists of diagrams from the same member from freight trains going north. These diagrams show very clearly the behavior of the eye-bars when carrying trains of this character; that part of the diagram formed by the engine load has the same characteristics as those formed by the passenger engines. The effect of empty cars in different parts of a loaded train are well shown in diagrams Nos. 23 and 35. It will be noticed that the diagrams formed by freight trains are, as a rule, much more uniform than those formed by passenger trains, while the vibrations become more marked. In diagram No. 27 we have a case of the train load approaching closely to the maximum engine load; in that portion of the diagram where the truck loads are most marked, the train load is over 80% of the maximum engine load. This diagram was formed by a coal train of large gondolas, followed by a smaller one of the four-wheel type.

In Fig. 9 we have a few diagrams taken from the lower chord near the center of the bridge. The greatest length between centers of instrument obtainable on this eye-bar was 12 ft., hence the diagrams are on a small scale, and, again, the vibration in the chord was so excessive that we have doubts as to the recorded results being the actual elongations of the bar. That is, we fear that when the levers move as quickly as they did on this bar, their momentum may have carried them on so as to record an elongation greater than that which actually existed. Having demonstrated to our own satisfaction, by jars and blows on the instrument and its connections, that the vibrations recorded came through elongations of the eye-bar, and not through any lateral movement of the instrument or bar, although the extreme movement of the pencils may be doubted, the diagrams show that the stress in the lower chord is subjected to extremely rapid longitudinal vibrations. This vibratory stress tends to increase to a certain point, then to decrease at about the same rate, only to increase and decrease again in succession until the train has passed. This fact would be expected from the result obtained by Professor Robinson in his diagrams showing the vibration and deflection of bridges as a whole.

This figure completes the series of diagrams taken from the bridge south of Ithaca, on the Lehigh Valley R. R. They do not show any new law or fact not already known to the profession, and if any were suggested, the series is not complete enough to prove them. Still, the writers believe they do present a true story of the work done by the various members of the bridge during the passage of the different classes of traffic.

Fig. 10 shows diagrams taken from the four bars forming the two hip-verticals at the south end of the south span of the Fall Brook Ry. Co.'s bridge over the Chemung River, at Corning, N. Y. This bridge was built in 1876. It carries a single track, and consists of three 164-ft. spans; the trusses are of the single-intersection Pratt type, divided into 12 panels, each 13 ft. 8 ins. in length, the distance between centers of chord pins being 22 ft., and between trusses 15 ft. 6 ins. The end panel is slightly shorter than the others, it being 13 ft. 1 in. between the hip-vertical and the center of the bearing plate at the abutment. The floor system consists of built floor beams and stringers. The stringers are riveted to the floor beam in the ordinary manner, with their upper flanges nearly on a level. The floor is suspended from the trusses by double hangers 14¼ ins. c. to c. These are of the ordinary yoke form, the inner of the two being made of a bar $1 \times 1\frac{1}{2}$ ins. in section, and the outer of a bar 1 in. square. The lower lateral bracing consists of round rods passing through the webs of stringers and floor-beams. This bridge is shown in Fig. 11.

The eye-bars composing the members were not in good adjustment, and the bridge vibrated considerably under loads moving at comparatively low speeds.

The diagrams in Fig. 10 were taken with a distance of 18 ft. between instrument centers, hence 1 in. of diagram is equivalent to 5,185 lbs. per sq. in. of eye-bar. A second line underneath some of the diagrams on these sheets was made by an electrical attachment, by which it was attempted to record the passing of the first wheel of the engine over the center of the span and over the bearing plate of the stringer at the abutment, in order to locate the engine, with a view to determining the cause of any characteristic points on the diagrams; this apparatus, however, did not work satisfactorily. All the diagrams in Fig. 10, except No. 167, were taken from the same engine. No. 141 is a consolidation belonging the Fall Brook Ry. Co.'s "Class B." These diagrams are plotted to read from left to right and not from right to left, as in the case of those taken from the other bridge.

It was thought that the arrangement of hangers in this bridge would throw a considerably greater portion of the stress in the member on the inner bar than on the outer. The diagrams shown, as well as many others taken under the regular traffic of the road, were taken for the purpose of deter-

mining what the distribution of stress actually was. The results tend to show that the adjustment of the eye-bars had more to do with the distribution of stress than the double hangers, even with this exaggerated case of the inner hanger having a greater section than the outer, and a somewhat greater distance between their centers than is common. If the distribution should be computed on the supposition that the floor beam does not deflect, the stress carried by the two hangers would be as 3 to 2, and the stress conveyed to the outer eye-bar would be only 66⅔% of that to the inner; any deflection in the floor beam would elongate the inner hanger more than the outer, thereby increasing the difference in stress. In the east truss, when the bridge was unloaded, the outer eye-bar of the hip-vertical was loose enough to be easily rattled by the hand, while the inner bar was tight, and seemed to carry all the dead load. In the west truss, however, the dead load tension in the two bars was about the same, the inner carrying, if anything, a little less than the outer. By referring to diagrams No. 146 and 167, from the inner and outer bars, respectively, it will be seen that the maximum stress was the same in both cases; these diagrams were taken at the low speeds of 9 and 2 miles an hour. The writers are confident that there is no instrumental error where the diagrams are as smooth as in No. 167 and in the first part of No. 146. The three places after the maximum was reached in the latter diagram, where it shows excessive vibration, were recorded by the instrument when a sudden jarring of the bridge took place; this jarring seemed to be in a vertical direction, and was very apparent to the writers standing on the lower chord near the instrument. These two diagrams were taken with the same class of engine, and if there had been any unequal distribution of stress between the two eye-bars, they would have shown it. The other diagrams in Fig. 10 were taken from engine No. 41, at speeds varying from 18 to 25 miles per hour. While these diagrams show sharp points of maximum stress running above the computed curve, the average of those on the outer differ by only 2 or 3%. from the average of those on the inner bar. It will be seen that the diagrams give more vibration for the inner bar than for the outer, but that the vibration of the outer bar during the time that the engine was on the span, but not on the stringers supported by the hip-verticals, shown by that portion of the diagram which is nearly horizontal, is sharper and quicker than in the inner bar. In diagram No. 122½ this vibration takes place before and after the passage of the engine—that is, the bar still vibrates after the engine has left the bridge when running south. These vibrations the writers believed to be caused by the floor system; the stringers, being rigidly connected to each other and to the floor-beams by the same rivets, tend to act as a continuous girder and to transmit their vibrations to the hip-vertical, as well as to all other members of the bridge; it is also believed that this continuity of stringers relieves the hip-verticals from a portion of their load, which, from diagrams Nos. 146 and 167, would seem to be about 300 lbs. per sq. in. in this case. If this is the case, it means that the rivets connecting the stringers to the floor-beams are subjected to a stress for which they are seldom, if ever, designed. It would also tend to show the impossibility of determining the effect of impact from hip-verticals when the stringers and floor-beams are rigidly connected.

In the hip-vertical of the east truss, the outer bar was quite loose, and, as a result, we find that the average stress taken by the outer bar is about 80% of that taken by the inner. It is also true that the diagram from the inner bar corresponds closely with the computed diagram, which has been calculated for the stress per square inch on the supposition of each bar taking equal stress, consequently the sum of the stresses in the two bars, as derived from the instrumental diagrams, does not equal the computed stress for the member; this the writers again attribute to the continuity of the stringers.

It is evident from the diagrams that the inner bar takes all the vibration until the load becomes heavy enough to elongate it sufficiently to transmit stress to the outer bar, when the effect seems to be about the same in either.

The diagrams thus far given are fair samples of over 200 taken from the two bridges. Some were taken with speeds as low as one mile per hour, and even less; but as they were very long in consequence, and agreed closely with those of five and six miles per hour, the latter have been shown instead. The bridge at Corning is so situated that greater speeds than those used were not obtainable.

As before stated, the writers are unable to draw any definite conclusion from the series, either in contradiction or confirmation of the impact theory. Still they believe that many of the diagrams do show an increased stress over that from the static loading, which may be due to the vibration of the bridge and to the sudden application of the loads. They also believe that the rigidity of the floor systems has hidden a part of this increased stress in the case of the hip-verticals, which were the only members available for this investigation under the regular traffic. Other members could be used for this investigation if a train could be obtained in which the distribution of the loads is known. Such a train, however, was not at the disposal of the writers.

In Fig. 12 are given a few diagrams taken from a double intersection Pratt truss, situated at Ithaca, on the Auburn & Ithaca branch of the Lehigh Valley Ry. The bridge is of wrought iron. The floor system consists of built wrought iron floor beams and timber stringers, resting on the upper flanges. The bridge is built on a curve of about 3°, and is also on a skew. Under these conditions it was thought that a few interesting diagrams might be obtained from the lower lateral bracing, which was so arranged that the instrument could be conveniently attached to it. Diagrams were accordingly taken, but they did not show the large amount of stress which the writers expected to find, upon considering the situation of the bridge. The rod to which the instrument was attached is shown on the plate. It was in good adjustment, and had considerable initial tension. Some diagrams were also taken from the three members of the outside truss meeting at the hip of the truss namely, the hip-vertical, short diagonal and first long diagonal. These show clearly the distribution of stress, the maximum stresses in the hip-vertical and short diagonal being about 5,000 lbs. per sq. in., whilst in the long diagonal it rises above 8,000. The uncertainty of the stresses in a double-intersection bridge appears from this to be not only a matter of theory, but also of practice. As the writers had no engine at their disposal, and the ordinary trains on this line run very infrequently, the length of time required prevented them from taking diagrams from the other members of the bridge.

The absence of vibrations from the diagrams taken from trains at from 30 to 50 miles an hour is very marked when compared with those taken from the single-intersection trusses. This may be due to some extent to the timber floor system and the steadying of the train by the curve, but the writers believe it to be principally the influence of the double-intersection system.

The subject of the stresses and their distribution among the bars which compose the members of a bridge are of great importance, and it is hoped that others may be able to carry on its investigation under circumstances more favorable than those under which these experiments were attempted.

There can be no doubt that an instrument giving reliable results could be usefully applied in many ways, such as in the determination of the distribution of stress in double-intersection bridges, or in any case where the stress cannot be accurately computed, or the determination of the stresses in the bars of any member where there is a likelihood of uneven distribution from any cause whatever, as bent pins, etc. With a series of tests, some more definite knowledge might be obtained on the effect of grade, curvature, impact, and, where a continuous record is obtained, the effect of cumulative vibration due to the correspondence of panel length and spacing of car wheels. Some light might also be thrown upon the influence of different structural details, as fixed and suspended floor beams, and in the latter case the influence of double and single hangers, riveted and pin connections, etc.

The writers offer these few diagrams, together with a description and drawing of their instrument, with the hope that they may be of value to any who may carry on the work.

THE FRENCH ALUMINUM TORPEDO-BOAT.

In a paper recently read before the British Institution of Naval Architects, Mr. A. F. Yarrow described the building, for the French Government, of a torpedo-boat with an aluminum hull. About two years ago France determined upon introducing a second-class torpedo-boat into its navy, in which boat lightness was to be a paramount consideration. Proposals were invited, and Mr. Yarrow's firm obtained the contract.

As the result of many experiments and tests aluminum plates, 50% thicker than steel plates applied to a similar use, were adopted for the hull. As, bulk for bulk, aluminum is about one-third the weight of steel, the weight of the hull was thus reduced one-half. The result of four tests of pure aluminum plates showed that the ultimate strength ranged between 7 and 8 tons per sq. in. Some alloy was thus evidently necessary, and 6% of copper was finally determined upon. The strength of this alloy varied considerably during rolling. If soft rolled, or annealed after the last rolling, the strength varied from 11 to 12 tons; if hard rolled, the strength was greatly increased but the metal proved brittle. As a result of these experiments the 6% alloy was rolled to a medium degree of hardness giving from 14 to 16 tons per sq. in. ultimate tensile strength, combined with a toughness which permitted the plates to be hammered into shape cold, and bent at a sharp angle without cracking. The framework was made of angles of the same material, and plates and frame were all shaped cold.

All parts subjected to the action of sea or bilge water were riveted with aluminum rivets; in the decks and parts not subject to this influence soft iron rivets were used.

Experiments upon corrosion were made, extending over 12 months. They found that where no galvanic action existed, due to contact with other metals, the corrosion may be taken as under 4% per annum for plates ⅛ in. thick, with unpainted surface. But careful painting is recommended. In building lately an aluminum sailing yacht, at Paris, it was found that where copper fittings were in direct contact with the aluminum hull, galvanic action was very evident; and the same thing happened when the aluminum boat was moored near another copper-bottomed boat, and fastened to the same post by chains.

Heat and alkalies are the great enemies to the use of aluminum. It anneals at a comparatively low temperature, and thus loses strength, and alkalies act upon it rapidly. At a high temperature aluminum oxidizes with exceptional rapidity; at low temperature the film of oxide on the surface reduces the rate by protecting the metal from further action.

In the machinery in this boat aluminum bronze and manganese bronze were used wherever practicable. The engines were of the triple expansion type, and indicated on trial from 275 to 300 HP. The boilers were the usual Yarrow type, with copper tubes. The contract with the French government called for a boat 60 ft. long, 9 ft. 3 ins. beam and capable of making 18¾ knots for two hours with 3 tons of weight on board. The weight of boat, exclusive of the 3 tons, was not to exceed 11 tons. In the official trial of Sept. 20, 1894, the average speed during two hours under the above conditions was 20.558 knots, and the boat weighed only 10 tons.

In comparing this boat with one of steel, the approximate saving in weight by using aluminum was not less than 2½ tons. The machinery weighed about 40 lbs. per indicated horse-power, including the water in the boiler. The vibration at all speeds was inappreciable.

ENGINEERING NEWS

AND

AMERICAN RAILWAY JOURNAL.

Published Weekly at Tribune Building, New York.
Entered at the Post Office, New York, as Second Class Matter.

VOL. XXXIII. THURSDAY, MAY 9, 1895.

D. McN. STAUFFER, A. M. WELLINGTON.....EDITORS.
GEO. H. FROST.....BUSINESS MANAGER.
F. P. BURT.....ASSISTANT MANAGER.
CHAS. W. BAKER, E. E. R. TRATMAN, M. N. BAKER,.....ASSOCIATE EDITORS.
A. B. GILBERT.....EDITOR CONSTRUCTION NEWS.
CHAS. W. REINHARDT.....CHIEF DRAFTSMAN.

CHICAGO OFFICE: 1,636 The Monadnock.
CHAS. S. HILL.....RESIDENT EDITOR
F. A. PECKHAM.....ADVERTISING MANAGER

EUROPEAN AGENCIES:
KEGAN PAUL, TRENCH, TRUEBNER & Co. (Limited), Paternoster House, Charing Cross Road, London, Eng.
SAMPSON LOW, MARSTON & Co. (Limited), St. Dunstan's House Fetter Lane, London, Eng.

SUBSCRIPTION RATES: United States, Canada and Mexico, One Year, $5.00; 6 months, $2.50; 3 months, $1.00; single copies, 15 cents. To all other countries in the Postal Union, add $2.08 per annum (4 cents per number) to above prices for postage. No club rates allowed. Mailing addresses may be changed at will by sending both old and new address. We shall be obliged if subscribers who fail to receive their papers promptly will notify us without delay.

The date when the subscription expires is on the address label on each paper: the change of this to a subsequent date is the only receipt sent, unless by special request.

ADVERTISING RATES: 20 cents per line agate measure. Want notices, special rates, see page 22. Rates for standing advertisements sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements by Wednesday noon.

The wonderful endurance of the 18-in. Harveyized armor-plate, tested at Indian Head on May 1, has turned the battle, for the time being, against the guns. American-made armor plate, at 100 yds. range, was neither cracked nor penetrated by 12-in. projectiles of the highest modern type, and for all practical purposes it successfully withstood the attack of a 13-in. gun with the enormous striking energy of 25,000 ft.-tons developed in its half-ton projectile. As the newly-tested reforging process is recognized as adding still further to the protective value of armor plate when weight and thickness are considered, it seems evident that the armor is now well ahead in a long contest. How long it will remain so is for the designers of ordnance to attempt to decide. One outcome of the recent test seems certain, and that is the advisability of arming the new battleships with 13-in. instead of 12-in. guns, even at the risk of greater displacement than was at first planned. The ordnance officers who have been contending for the heavier battery against the advice and wishes of the construction bureau, claimed that a smashing blow was the most efficient, and that this could not be obtained with the 12-in. gun. This test conspicuously confirms this view, for the 18-in. armor was practically uninjured by the 12-in. shot; and under the conditions and at the range of actual battle, it would have received even less injury than it did. The 13-in. projectile also failed to penetrate, but the smashing effect was present, and harm must have resulted to any one who should have been behind it. The margin in striking energy between the 12 and 13-in. projectiles was not very large, but the additional 3,000 ft.-tons of energy evidently counted in the case of the 13-in. shot, and it was all needed to make an impression on the plate. From the result of this test it may be said that against armor of this type the 12-in. gun was not only inefficient, but the 13-in. gun was none too heavy. The two guns in question are 45 ft. and 60 ft. long respectively, and the question of placing and handling the longer and heavier gun on board ship becomes a serious consideration which naval constructors fully recognize. In any event, a new chapter has been added to the records of the long and shifting struggle for supremacy between gun and target, and the outcome apparently means larger and heavier warships.

English trade possibilities in China, under the new conditions imposed by the pending Japanese-Chinese treaty, have revived interest in the Calcutta-Hong Kong railway, proposed in 1864 by Sir Macdonald Stephenson. He then projected a line passing through the north of Burmah, and through the south of the Province of Yunnan, in China, and finally splitting into two lines, one passing up the valley of the Yangtse-Kiang, and on to its mouth at Shanghai; the other following the valley of the Choo-Kiang to Canton and Hong Kong. "The Engineer," in commenting on this project, suggests that under the changed conditions, and in view of recent experiences, the Chinese authorities may look with more favor upon foreign improvements and innovations than in times past, and Chinese railways may become a fact instead of an idea. The Calcutta-Burmese route is not only actually surveyed, but construction has commenced, and with India, Burmah and the richest provinces of China all connected by rail, and opening upon three great English ports at Shanghai, Hong Kong and Calcutta, England sees magnificent prospects for the development of English commerce. As the writer in "The Engineer" says, "the idea is exhilarating truly."

But, as viewed from this side of the Atlantic, the prospect for a speedy, economic development in China is not as encouraging as Englishmen would wish, if English effort is alone to be depended upon. According to the best accounts, comparatively very few of the 300,000,000 Chinese even realize that there has been a war with Japan, and fewer still appreciate the full meaning and outcome of this war. With no respect for their own government, no patriotic feeling and a government policy and system corrupt to the core, the national prejudice against foreign innovation and any change in normal conditions is quite as strong now as in any generation past. In this past England, above all others, has had the ear of the government, and has had control of Chinese development on the lines proposed. In spite of all her wishes and efforts, Chinese apathy has stood as a Chinese Wall against this development, and little or nothing has been done that points to a true regeneration in China. The outcome of the late war proves the utter inefficiency of Chinese methods, and the weakness of Western efforts to change these methods for the better. If China is to be really civilized, it must be done by Asiatics; by a nation knowing Chinese peculiarities better than any Westerner can know them. Japan could doubtless work this revolution in time, as she has remodeled her own people in the remarkably short space of twenty years. But the development of China on Japanese models would awaken possibilities that would be antagonistic to all the selfish interests of the rest of the commercial world; and the question is—would the nations now controlling the manufactures and the trade of the world permit it. From the vigorous protests being made against the acquisition of Chinese territory by the victors, and against Japanese control in Chinese affairs, it is evident that Europe views with alarm and suspicion the rising power of Japan in the East, and is not disposed to permit Chinese growth under this new influence. As China, left to herself and her European backers, for self-interest alone, will probably continue in her old and well-beaten track, railway development and other internal improvements still seem to be events of the very distant future. On the other hand, Japan, in exacting new treaty privileges from China, and in demanding the opening of new fields of trade, takes a broad and sensible view of the situation, and makes these privileges common to the commercial world. This means a more rapid introduction of foreign methods into China than in the immediate past, and if that country should, by some social revolution, find itself led by men appreciating the possibilities of modern civilization, the change in system and general development may be more speedy than is now expected. The re-birth of Japan is a remarkable object lesson in that direction, and the rest of the world will do well to closely watch the outcome of what is undoubtedly a serious blow to Chinese tradition and egotism.

The report of Commissioner of Labor Carroll D. Wright upon the slums of New York, Philadelphia, Chicago and Baltimore, furnishes some interesting reading. Not the least startling of the statements made is the unexpected one that notwithstanding the wretched conditions encountered and the crowding of population in the sections investigated, there was a surprisingly small amount of sickness due to foul air and unsanitary surroundings, as that term is usually understood. Dr. Houghton, who conducted these investigations in New York and Philadelphia, says that without exception he found the air in the tenement houses as pure as in any residences visited, and an almost complete absence of pathogenic germs in this air. This statement does not at all agree with the usual ideas upon this head; but Dr. Houghton gives a reasonable explanation for the actual conditions found. The worst state of affairs would be expected in winter, with doors and windows closed; but, while the percentage of carbon dioxide was then found to be increased in many cases, the smoke of open fires and the low temperature generally maintained, owing to lack of sufficient fuel, actually reduced the bacteria in the air to almost nothing. The wretched surroundings and general poverty of the residents of the slums were actually protective agents, in this case, against diseases due to foul air. Carpets, upholstered furniture, curtains, etc., which in homes of the rich and the middle class hold and develop bacteria, are all wanting here, and the scanty, bare furniture in use is practically a safeguard against the harboring of germs prejudicial to health. This result is the more surprising because the canvassers reported that in New York 6,576 persons, out of a total slum population of 28,050 investigated, slept in rooms without an outside window, and in almost all cases the ordinary sanitary conveniences were of the most primitive type.

France, in 1842, inaugurated the system of granting state aid to railway companies, instead of leaving the railway development in individual hands, as did most other countries. The chief plan of assistance was the guarantee of a certain interest on railway securities, or the deficiency in this interest not earned by the companies themselves. The expense to the state increased rapidly, until in 1895 the public treasury finds itself called upon to pay out the sum of $23,980,000 on this account. The various steps taken in this extension of state aid to railways is interestingly told in a recent issue of "Engineering," and that journal points out the serious complications arising therefrom, which have had no small part in bringing on the recent severe political crisis in that country. The weak point in the system lies in the fact that the government has assisted unprofitable as well as profitable railways, and while the companies are supposed to pay back this money at some future time with 4 per cent. interest added, the fact is that in many cases the confiscation of their entire plant and rolling stock would not now discharge their accumulated indebtedness. France is not only paying interest on these practically useless roads, but she is also obligated to spend many more millions on the construction of new lines which, when completed, will have very little traffic, and will add materially to the annual interest account. A number of French statesmen are now pointing out the fact that the bulk of these enterprises can never be so developed as to make any return to the state for the money expended, and they think the time has arrived to call a halt. The system has certainly proved beneficial to the railway companies and to their shareholders; but the question now is whether the state is not paying too much for these individual benefits. Under the existing conditions there is no incentive for the railway companies to improve their facilities and stimulate traffic, for any surplus must be paid back to the state under their agreement; and when companies have been obliged by persistent demand to increase the number and speed of their trains, the added expense

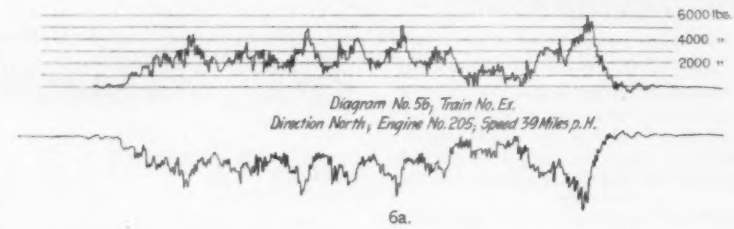
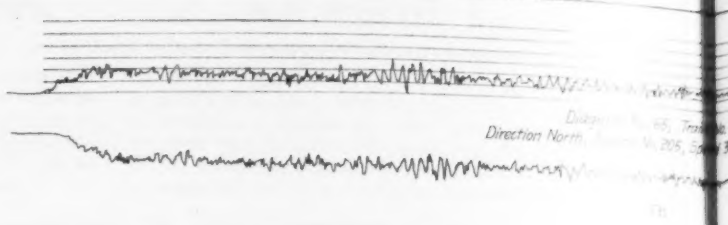


Diagram No. 56, Train No. Ex.
Direction North, Engine No. 205, Speed 39 Miles p.H.

6a.



Direction North

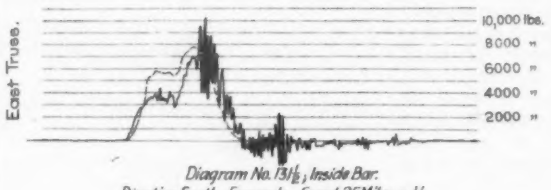


Diagram No. 131½, Inside Bar.
Direction South, Forwards, Speed 25 Miles p. H.

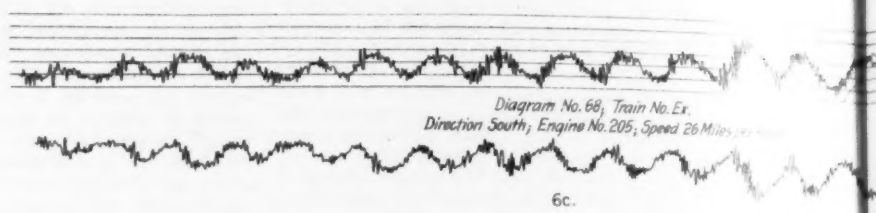


Diagram No. 68, Train No. Ex.
Direction South, Engine No. 205, Speed 26 Miles per Hour.

6c.

FIG. 6. DIAGRAMS FROM HIP VERTICAL UNDER FREIGHT TRAINS.

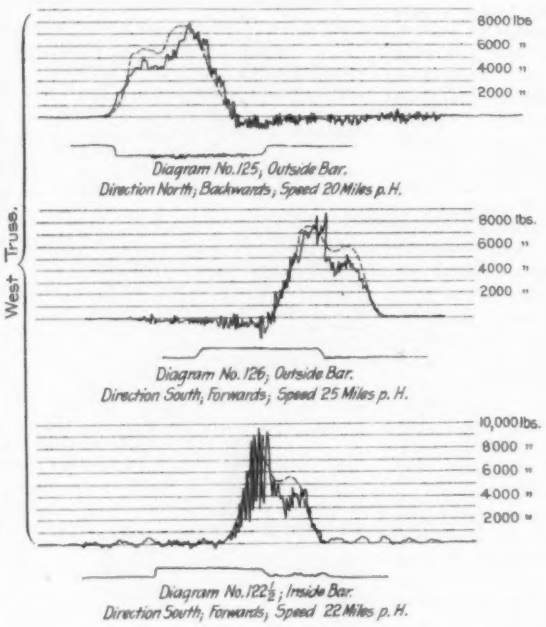


Diagram No. 125, Outside Bar.
Direction North, Backwards, Speed 20 Miles p.H.

Diagram No. 126, Outside Bar.
Direction South, Forwards, Speed 25 Miles p. H.

Diagram No. 122½, Inside Bar.
Direction South, Forwards, Speed 22 Miles p. H.

10a.

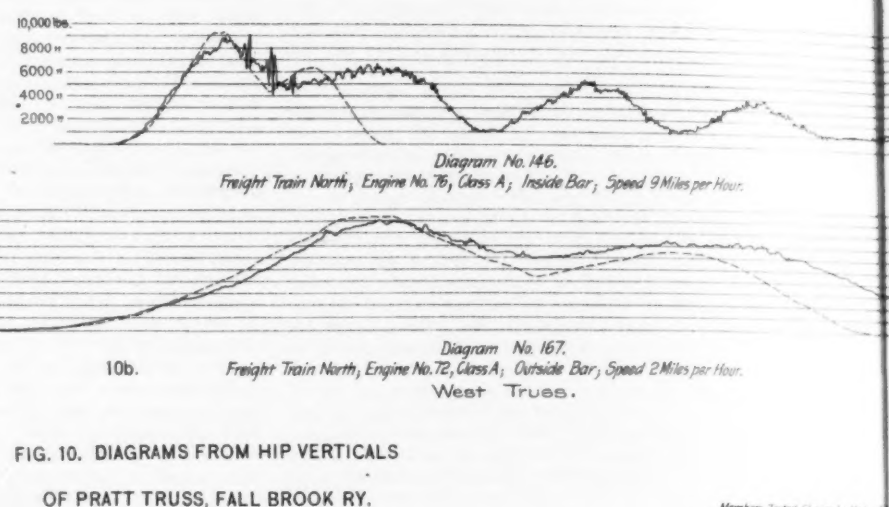


Diagram No. 146.
Freight Train North, Engine No. 76, Class A; Inside Bar; Speed 9 Miles per Hour.

Diagram No. 167.
Freight Train North, Engine No. 72, Class A; Outside Bar, Speed 2 Miles per Hour.

10b. West Truss.

FIG. 10. DIAGRAMS FROM HIP VERTICALS OF PRATT TRUSS, FALL BROOK RY.

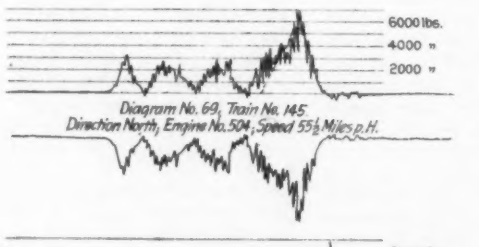


Diagram No. 69, Train No. 145
Direction North, Engine No. 504, Speed 55½ Miles p.H.

Diagram No. 44, Train No. 145.
Direction North, Engine No. 504, Speed 52 Miles p.H.

Diagram No. 24, Train No. 12.
Direction South, Engine No. 504, Speed 34 Miles p.H.

FIG. 5. DIAGRAMS FROM HIP VERTICAL UNDER PASSENGER TRAINS.

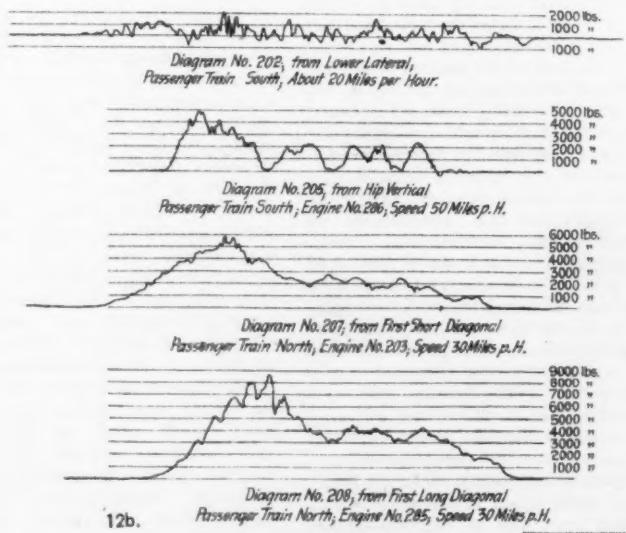


Diagram No. 202, from Lower Lateral,
Passenger Train South, About 20 Miles per Hour.

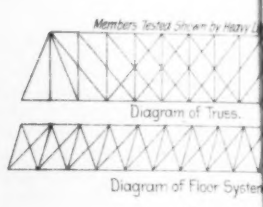
Diagram No. 205, from Hip Vertical
Passenger Train South; Engine No. 286, Speed 50 Miles p.H.

Diagram No. 207, from First Short Diagonal
Passenger Train North, Engine No. 203, Speed 30 Miles p.H.

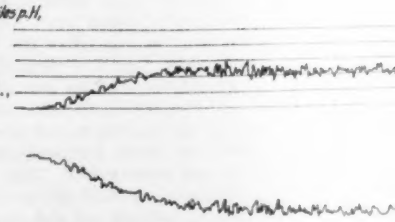
Diagram No. 208, from First Long Diagonal
Passenger Train North, Engine No. 285, Speed 30 Miles p.H.

12b.

FIG. 12. DOUBLE INTERSECTION TRUSS ON AUBURN & ITHACA BRANCH, LEHIGH VALLEY RY., AND DIAGRAMS TAKEN FROM ITS MEMBERS.



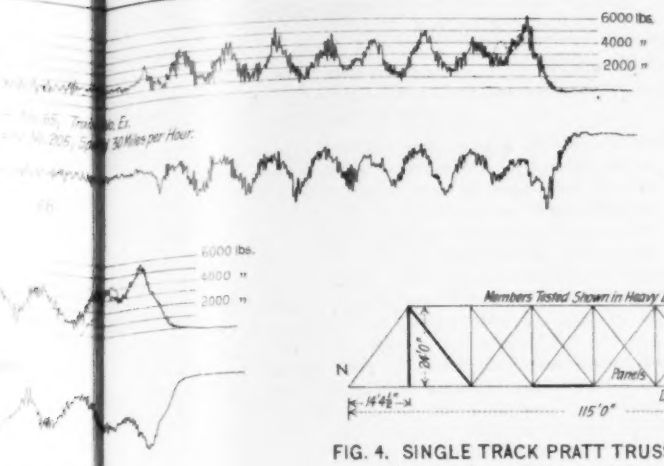
12a.



FI

THE MEASUREMENT OF LIVE LO

Diagrams Taken by J. Jay Hanken



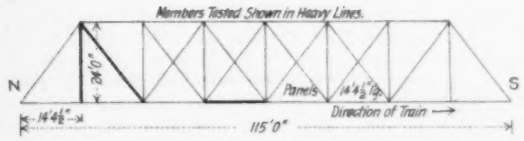


FIG. 4. SINGLE TRACK PRATT TRUSS BRIDGE ON LEHIGH VALLEY RY., FROM WHICH DIAGRAMS IN FIGS. 5 TO 9 WERE TAKEN.

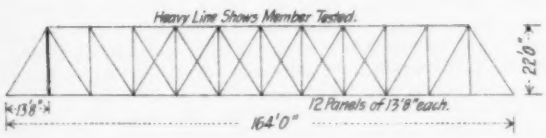
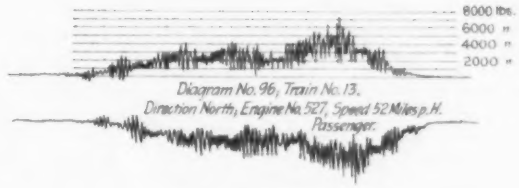


FIG. 11. SINGLE TRACK PRATT TRUSS BRIDGE ON FALL BROOK RY., FROM WHICH DIAGRAMS IN FIG. 10 WERE TAKEN.



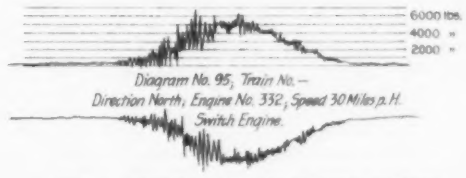
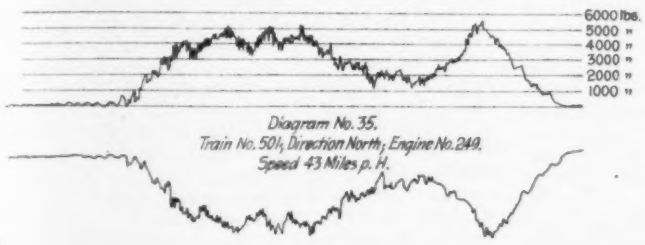
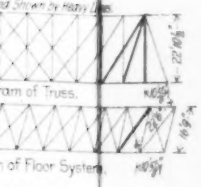
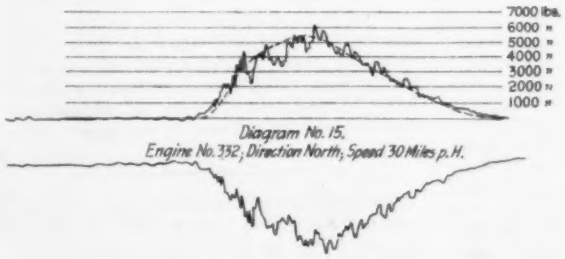


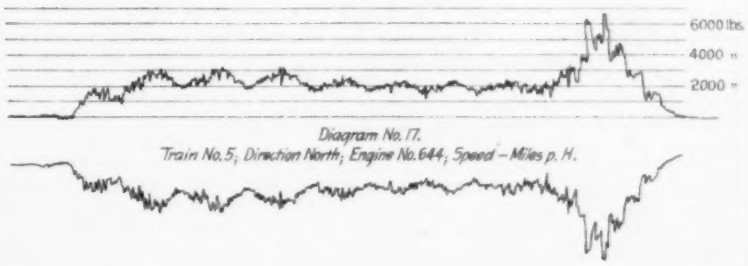
FIG. 9. DIAGRAMS FROM LOWER CHORD NEAR CENTER OF SPAN.

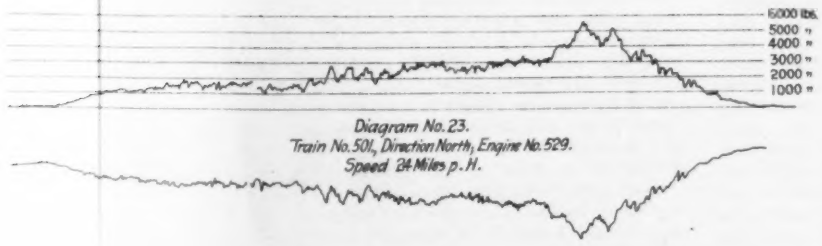


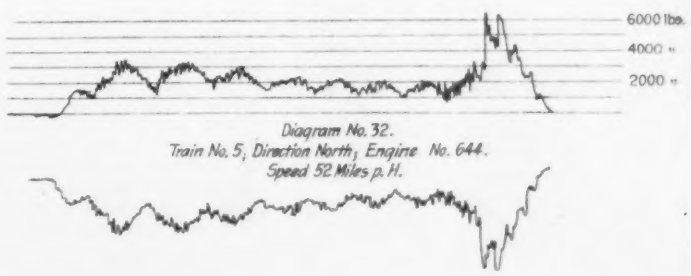


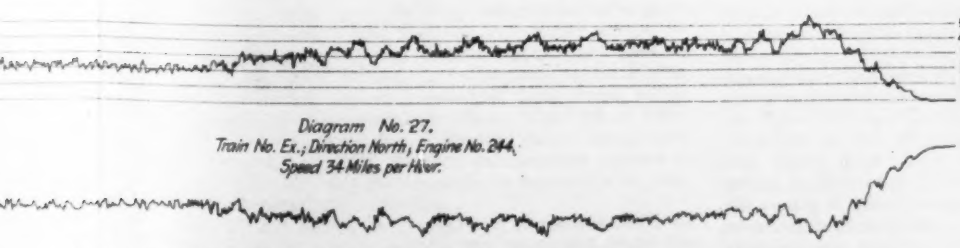
12a.











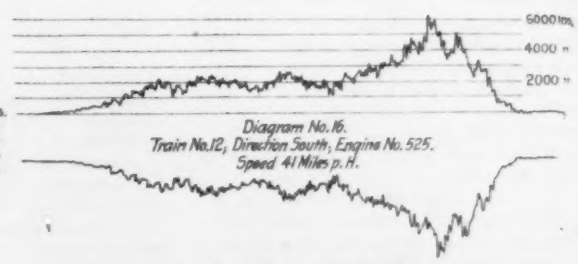


FIG. 7. DIAGRAMS FROM MAIN DIAGONAL UNDER PASSENGER TRAINS.

FIG. 8. DIAGRAMS FROM MAIN DIAGONAL UNDER FREIGHT TRAINS.

LIVE LOAD STRAINS IN BRIDGE MEMBERS.

Hankenson, C. E., and Wm. H. Ledger, B. E.

CHAS. HART & SONS, LITH., 26 VESEY ST., N. Y.

usually falls upon the public. It is evident that there is abundant room for a marked change in railway methods in France.

Since our last issue the names are announced of a special board of examiners, appointed to report upon the qualifications of applicants for the important position of Chief of the Water Bureau of the City of Philadelphia. As we said last week, the fitness of the man selected for the place must depend very much upon the composition of the examining board and upon the spirit in which this board performed its duties. We are glad to be able to state, therefore, that a special board has been appointed for this work, made up of men of high personal and professional reputation, fully equipped to perform the duties imposed upon them. These men are Messrs. William Sellers and Thomas M. Eynon, of Philadelphia, and Prof. Mansfield Merriman, of Lehigh University. In thus going outside the official Civil Service Board for men to pass upon the fitness of candidates for one of the highest offices coming under the Civil Service Regulations the action of the appointing power is to be highly commended. The personnel of this board gives full assurance that the men selected by it to be placed on the "eligible list" will be well fitted by character, education and experience for the important office in question; provided, of course, that this board has before it suitable candidates from which to make its selection.

While the regulations under which this board will act in no place distinctly state that the applicants shall be citizens of Philadelphia, the form of questions and the blanks provided require this citizenship by implication, and in so much limit the field of the examiners. The final selection lies with the Mayor, to whom this special board will submit a list of applicants passing with a rating of 70 or over, and the test of citizenship will doubtless have its weight when the appointment is made from the eligible list. But Philadelphia is a large city, and among its many able engineers a man thoroughly competent to fill this important office can doubtless be found. The case itself is somewhat unique from the importance of the position falling under Civil Service Regulations; but, in comparison with former methods of filling similar offices, and in connection with the wisdom shown in choosing fitting men to make the selection, the new departure is in the line of obtaining the best man for the place, from a point of merit alone and regardless of previous political or personal affiliations.

THE FREE AND PROMISCUOUS DISTRIBUTION OF GOVERNMENT PUBLICATIONS.

In the fiscal year ending June 30, 1894, the sum of $3,922,981.83 was expended by the Public Printer of the United States for labor, materials, paper, etc. This is a goodly sum to take out of the pockets of the citizens of this country, and it is altogether natural to ask how this money was spent and what direct measure of benefit was secured by the public from the expenditure. It is a rapidly growing account; and the total for 1894 exceeds that of 1887, the oldest return at hand, by $1,640,880, with a steady increase for each intervening year.

An inspection of the last annual report of Public Printer Thomas E. Benedict shows that much of this printing was necessary for the regular working of the many departments of a great government; and from the exceedingly minute detail of the report it does not appear that the item prices paid were excessive, or that the administration was any more wasteful than would be expected in a government office. The item of labor alone accounts for $2,894,304; paper comes next, with $591,734; material and supplies amount to $325,627, and the remainder is chargeable to lithographing and engraving.

The total is by no means an excessive price to be paid by a great country like the United States for the spreading abroad of information useful to the whole people. But a study of the present methods of both publishing and distributing this printed matter proves them to be absurdly wrong; and as a consequence a great part of the current expenditure is wasted in keeping up a tradition that has long outlived its purpose and usefulness. In the early days of our national existence, with a comparatively small population and with limited means and need for distributing public documents, the Senators and Representatives could, perhaps, better than any other men, recognize the individual requirements of their constituents in this distribution. The cost to the general government resulting from free distributions was small, for the publications were comparatively few in number, and they lacked the profuse and expensive illustration that is now so often deemed requisite. But, as the country grew in population, wealth and influence, its publications naturally increased, and Congressmen recognized in the free distribution system, already inaugurated, a ready and easy means of advancing personal political aims. Reams of paper were used up at government expense in spreading among their constituents, speeches that were never delivered in the Hall of Congress; agricultural and patent-office reports were sent where they imagined some personal end might be promoted, and hundreds of tons of garden seeds were shipped through the mails to people who were always ready to receive what cost them nothing. The evil spread until it assumed its present huge dimensions, and more than one department officer of the United States now recognizes the fact that the time has arrived for calling a halt in this waste of effort and money.

If this material, freely distributed through Senatorial or Congressional favor, really reached people who appreciated it and could make some use of it, the objection would not be so marked. But that this is not the fact is very evident. Even the distributors will not all avail themselves of their privileges, and their quotas accumulate and rot in the basement of the House of Representatives until, according to the report of the late Congressional Committee on ventilation and improved sanitary conditions, any disturbance of the lower layers of these decaying documents would sicken the men at work upon them. Other Congressmen avoid the trouble of sending out their particular ton or two of books by selling them in bulk to a junkman or a second-hand dealer in books; and a late case is quoted by the Department of Agriculture where one retiring Congressman disposed of his quota of garden seeds for a discounted cash consideration to one of the clerks of the department.

The waste of material and labor in publishing these books, etc., is not the only drain upon the public purse. Secretary Morton, of the Department of Agriculture, writes this journal, in answer to a query, that during the last year his department alone furnished for free carriage through the mails more than 600 tons of documents, bulletins, and other printed matter, and more than 400 tons of seeds, in addition, "gratuitously, promiscuously and uselessly distributed." Secretary Morton, in his annual report, vigorously assails this iniquitous system and charges it directly with causing a tremendous deficiency in the postal service. As he well points out, this free, promiscuous distribution too often exhausts editions of valuable bulletins and other documents by distributing them among those who cannot appreciate them and do not care for them. As a consequence, some of the best papers ever issued at public cost end their existence in the kitchen stove or are destroyed by the thoughtless for the illustrations they contain. In the mean time, those who do want them cannot get them on any terms.

On seeking for a remedy to these acknowledged evils it is not the purpose of this journal to call for a stoppage of publication on the part of the government. It would rather advocate an increase in the annual expenditure, if this expenditure could be wisely made and the true interests of the people of the United States were consulted. It is within the power and province of the government to investigate and report upon many subjects outside of the means or inclination of individuals, and so long as the results of this investigation are valuable to any considerable class of the community, they should be published and paid for by the government.

But what we would heartily recommend is that reform so forcibly urged by Secretary Morton, that government publications should be placed on sale to the general public, at the cost of production and postage; and further, that the present free and promiscuous distribution of seeds and documents by members of the Senate and House should be absolutely stopped. Further than this there should be a rigid censorship of what is published at government expense. Tons of documents are annually paid for by the people of the United States that are not even of passing public value. If a blatant Congressman wishes to spread his crude, disjointed views before a tired public, let him do so at his own expense in every item; he is about the only person really interested in the publication. The Act of Jan. 12, 1895, providing for the public printing, binding and distribution of public documents, does require the Senator, Representative or Delegate to pay the cost of printing extracts from the "Congressional Record," etc.; but the same law says that the Public Printer shall furnish envelopes for distribution, at the cost of the government, and the U. S. mail is required to transport this matter free of cost to the sender. This may be a small matter comparatively: but it is one of the items that help to clog the government printing office, and the time expended upon them could be better employed in more useful work.

A certain amount of free distribution of public documents would be permissible to public libraries and other designated depositories; but even in these cases the officials in charge of such distribution should see to it that the contributions are really useful and are desired by the recipients, and further, that they are made properly accessible to the public. Very few libraries worthy of the name or of patronage of this character will care to find shelfroom for all the documents published by the government, and they would find little or no call from readers for the mass of material if they did. The exchange system with foreign governments could be fostered and usefully extended. But the chief end should be to the stoppage of promiscuous free distribution after present methods. Every publication authorized by the government should have a price put upon it covering the cost of production, and postage added; and at regular and short intervals the public should be advised of the character of each publication, its cost and where it can be obtained.

Upon the latter provision would depend the whole value of the proposed reform. The Act of Jan. 12, 1895, provides that a catalogue of government publications shall be prepared by the Superintendent of Documents, an office lately created, and that 2,000 copies of this catalogue shall be printed for distribution on the first day of each month. This is a step in the right direction, though diligent inquiry has as yet failed to secure a copy of this authorized catalogue. Both the Smithsonian Institute and the U. S. Geological Survey now publish a price list of their publications, usually as an addendum to annual reports or special publications. What the people want, however, is something more than a mere copy of the title of a work or paper, which may or may not convey an intelligent idea of contents. The catalogue should briefly outline the subject matter; state whether it is illustrated or not, and give its author, source of issue and price. And means should be provided so that any one who really sought to keep track of the publications of the government, and expected to derive benefit from them, could regularly subscribe to these catalogues at a price covering the cost of making them more complete and generally useful. Promiscuous, free distribution of these catalogues would be quite as objectionable as the promiscuous scattering of the books they catalogue, and tend to defeat the end in view. This end is, or should be, the placing of these publications in appreciative hands, making them readily accessible for a minimum price to those who really need and are disposed to use them.

The English practice in this connection could be followed with some profit by our own government. The sale of official publications is there submitted to public competition, and the successful bidder is appointed by Her Majesty's Government the sole agent in England or Wales, or in any other broad division of territory, for the sale of these publications. Every Englishman, and many people in other countries, know that there is one place in London at which they can secure all recent government publications at a fixed and low price. They can buy for cash; they can regularly sub-

scribe for all documents or papers of a special class, or they can open a deposit account and have the papers sent to them on issue until this account is exhausted or renewed.

This designated firm issues catalogues at regular intervals, and by the aid of comprehensive special indices is prepared to give every assistance in tracing old papers of any date. Some government publications are excepted in this list, and other centers of distribution are given; but they are all on sale at designated prices. With regard to Parliamentary papers, current lists and order forms can be obtained at any post-office of any importance in the United Kingdom, and monthly lists are sent to any address upon application, and a consolidated alphabetical list is published quarterly and forwarded post free for 8 cts. With the exception of the publications of the post-office, the patent office, the ordnance and geological survey and the hydrographical charts, etc., of the Admiralty, this one London firm handles for the district named all the official publications of the English Government, of every character. The exceptions noted have their own centers of sale and distribution.

This is a scheme far in advance of the worse than wasteful methods of our own government in this direction, and we can only hope that the strenuous efforts of some few of the broader and wiser men in Washington may speedily result in some radical reform. There is absolutely no valid defence for the preservation of the existing system. It is responsible for the publication of a large amount of trashy matter that no one really wants; it loads down the mails with hundreds of tons of useless paper that increase a postal deficiency already large; it exhaust editions of valuable reports by wasting them upon unappreciative recipients, and keeps them out of the hands of those who could and would use them with profit; it encourages waste, or even wrong-doing, on the part of Congressmen who will not take the trouble to properly handle their quotas of books; it often places these Senators and Congressmen under awkward obligations, and subjects them to charges of favoritism in the distribution from those who believe they are entitled to "free books," but care little or nothing for the contents. The whole system is absurdly wrong, and altogether out of accord with the enlightened age we live in.

The reform proposed is a sensible one; would be economical, and agree with what should be the only warrant for publishing any matter at public expense—that the matter published should be really wanted by the public and be of such a character as to benefit the public. It would put a stop to the common practice of scattering mere campaign literature at the cost of the government for the sole benefit of political parties; for the purchase test applied to all official publications would soon weed out material for which there was no real demand. And beyond all this, it would vastly increase the usefulness of the many really valuable reports and documents published by our government, and furnish the best of incentives for increasing the number and scope of such official investigations. The new printing and publishing Act of Jan, 12, 1895, contains some provisions that point in this direction, but it preserves all the iniquitous features of the old scheme of "gratuitous, promiscuous and useless distribution." Is it too much to hope that a new Congress may so far rise above mere selfish, political considerations as to seriously consider this question from the standpoint of common-sense and better public policy?

LETTERS TO THE EDITOR.

ELEVATION FOR RACE-TRACK CURVES.

Sir: Replying to "Subscriber's" question concerning race-track curve elevation, I would say that in building a private track at Brandon, Vt., the outer elevation of the track was made with a rise of 1 in. per ft. of width of track at the turns from the back-stretch, and 1 in 15 at the other. The track is a half mile regulation track, radius of two end semi-circles each 226.2 ft., with a tangent 600 ft. long. Width of track is 30 ft. on stretches and curves, except where it is widened at starting post around to the middle of the first circle to 40 ft. This is done to get the horses well stretched out at the post.

The bicycle is used on this track, which was made to be fast, and to accomplish this, the curve from the starting post is made with a rise of 1 in 15, which has the added advantage of being an easy climb for the horses after starting. From this rise it is eased down to ½ in. to the foot at the P. C. and P. T. The tangents slope to the inside ¼ in. per ft.

Yours truly, C. H. Schumann.

265 Broadway, New York city, April 20, 1895.

TEST OF AN ELECTRIC RAILWAY POWER STATION.

Sir: Since publication of our article in Engineering News of March 7, entitled "Test of a New Design of Electric Railway Power Station," some questions have been raised which make it desirable to add a few words regarding two of our paragraphs, which do not appear to be quite clear.

The first concerns the efficiency of the economizer, as discussed in the paragraph beginning at the middle of column 2, p. 149. We wish especially to point out that our remarks are applied to this particular station only, and not to economizers in general. We are fully aware that different tests made under different conditions, especially with boilers operated to substantially their rated capacity, have shown far more favorable results, of 100° or more added to temperature of feed, and no comparison with them is attempted.

The other matter of doubt has arisen in connection with the phrase "this type of engine," in the paragraph on "Hunting the Governor," column 1, p. 150. By "this type of engine" it is to be understood that we do not by any means refer to the Westinghouse type, but rather to high-speed, shaft-governed engines in general. We do not know of any other case of "hunting" in a Westinghouse engine, and in this instance it will be seen that there was good evidence of the one engine on which the hunting occurred being out of order at the time. In justice to the apparatus in question, you will favor us greatly by noticing these points in your columns.

George W. Colles, Jr.

Hoboken, N. J., April 20, 1895.

WOOD PRESERVATIVES.

Sir: We notice in your issue of April 11 an article headed "Fernoline for Preserving Wood," and are very much astonished at the chemical analysis of fernoline given therein. The article says that fernoline is the product of the destructive distillation of yellow pine, and is said to be composed of 50% of wood creosote, 40% of oil of tar, and 10% of pine tar. We think this is not only incorrect, as far as the chemical analysis is concerned, but also does a grave injustice to the wood preservative obtained from the destructive distillation of yellow pine. As far as known to us, there are only two concerns in this country which distill yellow pine for the purpose of making a wood preservative, namely, the Fernoline Chemical Works, of Charleston, S. C., and the Fernandina Oil & Creosote Works, of Fernandina, Fla. The wood preservatives manufactured at either of the above two places are practically the same, differing in name only. The Fernoline Chemical Works has adopted the old Scandinavian name for its product, while the Fernandina Oil & Creosote Works gives its product the American name of "Pinoline."

Reichenbach, a prominent German chemist, who has given much time and study to the destructive distillation of woods, says that he first discovered creosote in the heavy tar oils obtained from leaf-bearing trees, but also found it in less quantities in needle-bearing trees, to which latter order the yellow pine belongs; in no case did he find more than 20%. Speaking further of creosote, he says that when separated from the heavy oils it is soluble to some extent in water, but more so in ammoniated water (rain water).

The Pennsylvania R. R., through its chemical laboratory, has issued a specification for a wood preservative to be used particularly for such purposes as named in the article above referred to, and this specification says:

> The material desired under this specification is a product of the distillation of yellow pine, containing as large an amount as possible of the preservative acids characteristic of this distillate, viz.: neutral oils, 50%; tar acids, 45%; tarry matter, 5%.

From the above it may be seen that a wood preservative in which a substance soluble in rain water predominates, as claimed in the published article, can hardly be called a wood preservative. We also would like to know the name and address of the chemist who has discovered 50% of crude creosote in the product derived from the destructive distillation of yellow pine. Such a discovery would yield immense fortunes to the discoverer, as well as to those engaged in that particular business.

Fernandina Oil & Creosote Works,
Per B. T. Burchardi.

Fernandina, Fla., April 18, 1895.

(This pinoline is said to be a pure wood oil, containing about 60% of neutral insoluble oils (paraffines), 25% of wood and tar acids, and 15% of crude creosote. The chemical composition of fernoline, as given in the article in our issue of April 11, was taken from the catalogue of its makers, the Fernoline Chemical Works, and as the material is used by the Pennsylvania R. R., it is evidently of a quality to meet the requirements of that company's specifications, which are given below. A similar preservative, not mentioned by our correspondent, but which is also used by the Pennsylvania R. R., is known at "Spirittine," and is manufactured by Hansen & Smith, of Wilmington, N. C. The makers state that it is manufactured by a special chemical process from the destructive distillation of pine and cedar. A sample tested by the Pennsylvania R. R. gave the results shown in the following table, which gives also the requirements of the Pennsylvania R. R. specifications:

	P. R. R. Spec.	Spirittine.
Flashing point	200° F.	214° F.
Burning point	220° F.	235° F.
Specific gravity	1.05	1.05
Temp. at w'ch material will run.	15° F.	15° F.
Tarry matter	5%	5%
Tar acids	45%	64.25%
Neutral oils	50%	30.75%

The specifications further say that material will not be accepted which flashes below 172° F., burns below 200° F., has a gravity less than 1.03, will not run at 20° F., has more than 12% of tar or less than 30% of tar acids.

It is probable that all these preservatives are really very much alike in chemical properties.—Ed.)

THE DISTINCTION BETWEEN CONCRETE-IRON AND IRON-CONCRETE.

Sir: There is such a great difference in the mode of combining these two often-used materials, according to which of the two is placed on the outside, that I believe a distinction should be made in the nomenclature in the manner indicated in the above heading. That is the material on the outside should stand first.

I was recently referred to a bridge in Prospect Park, Brooklyn, N. Y., as a "concrete-iron" bridge, and as one which gave all sorts of trouble. On a visit there I learned that it was a small arch which has on its outside a thin and very ornamental iron shell which has been filled in with concrete, this latter material supplying the bearing and floor, and which is deemed important enough by those viewing it to style it "concrete-iron." The difference between such a structure and a Melan arch, where the iron beams are entirely buried, is too evident to need further explanation.

I had the opportunity of showing to your readers in your issue of Sept. 27, 1894, that iron and concrete have the same coefficients of expansion, but I also pointed out the great difference which exists between them with respect to heat conductivity.

I should like once more to bring this to the attention of your readers by considering the two above-mentioned classes of construction.

In a combination where the concrete is on the outside, any sudden change in the temperature will only find its way slowly to the interior, and when it reaches the iron the latter will always remain at the same temperature as the surrounding concrete. In the other case, secondary stresses will arise on account of the difference in temperature. The concrete changes its temperature slowly while the iron on the surface is changing with every sudden change of the atmosphere, and the sun shining on it may heat it much hotter than the atmosphere. A separation between the two materials is soon induced therefore, and once formed, the difficulty in the transfer of heat from one to the other or the distribution of strain between the two is greatly augmented

Now, as this condemnable combination of "iron-concrete" is more generally known and used than the "concrete-iron," I deem it advisable to refer to two illustrations of its defects.

Iron tubes used as supports for bridges and viaducts are generally filled with concrete. This concrete is as a rule of a very poor quality, so that if a separation occurs, the water not only comes through the concrete, but also through the space mentioned above, and the entrance of water and air must rust and destroy the iron. It is necessary, in this case, not to rely on the the protective qualities of cement, but to specify that the iron tubes shall be provided with a separate protection inside against corrosion. Common paints, such as lead paint, are very inefficient, because the acids in the cement will destroy the pigment, and either galvanizing, graphite or tar paint would be advisable.

The question as to what is the right kind of paint to be used together with cement does not seem to be sufficiently investigated. In the case of concrete-iron construction, it seem to be the best practice not to use

paint at all, but the iron should be thoroughly cleaned before applying the concrete in the same way as if it were to be prepared for painting.

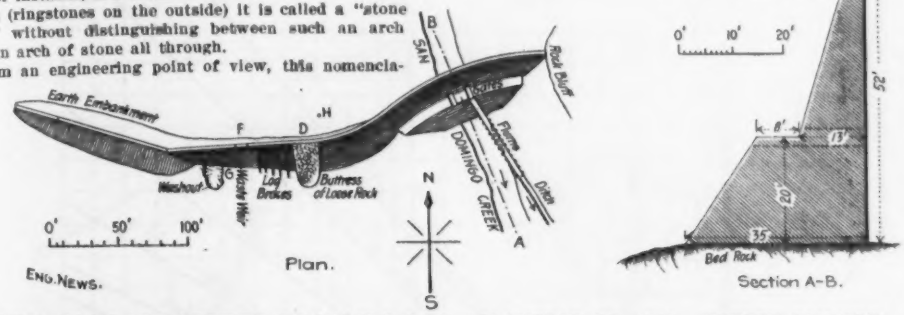
Another case of this kind is a pipe-railing with concrete posts. The posts are economically molded in place and the iron rods or pipe are often inserted in the mold. The iron gets its temperature from the outside parts and soon frees itself from its connection with the concrete, and water enters either by a capillary action or by a kind of pumping movement from expansion and contraction, and this will soon destroy the whole post, unless some precaution is taken to prevent it. The simplest way of meeting this difficulty is to mold the posts alone and leave holes for the iron to be inserted. Then fasten the iron in the same way as it is done in stone posts.

In any case whenever a combination of concrete and iron is to be used it should be looked at in the light of this investigation.

There is another construction, the nomenclature of which gives me a good deal of trouble, and which I sumbit to you to probably get from you or from some of your readers a suggestion how to deal with it.'

The engineer has to comply with the public idea of calling an arch according to the material in sight, as, for instance, if a brick or concrete arch has a stone finish (ringstones on the outside) it is called a "stone arch" without distinguishing between such an arch and an arch of stone all through.

From an engineering point of view, this nomencla-



SKETCH PLAN AND SECTION OF ANGELS DAM, CALAVERAS CO., CAL., BEFORE FAILURE.

ture is all wrong. It is almost the same as if we were to call an iron bridge painted with graphite paint a graphite bridge.

In advocating "concrete bridges," I was often understood and compelled to propose concrete for the exterior finish when I did not want to do so. I look on the exterior finish of an arch bridge in the same way as an architect who may build the interior of a house of brick and iron and give the whole a granite facade. I consider that the use of concrete for the bearing part is good engineering, but in regard to the facade, concrete is inferior to good stone, such as granite, and ranges in quality with sandstone, although it can be made ornamental at a far smaller expense.

Very truly yours, Fr. von Emperger.
71 Broadway, New York City, April 23, 1895.

FAILURE OF THE ANGELS MASONRY DAM, CALAVERAS COUNTY, CAL.

Sir: Herewith I enclose clipping from a local paper descriptive of the failure of a 50-ft. masonry dam in Calaveras County, Cal., on April 10, which, in a condensed form, may be of interest to your readers

In the course of a study of storage systems of that district I had visited the dam in question (then not quite completed) some three weeks before its failure, and, owing to its peculiarities of design and construction, I gave it considerable attention. The accompanying sketches show the cross-section and plan of the structure approximately.

The dam was owned and built by the Utica Mining Co., which operates its various hoisting works and quartz mills at the town of Angels by means of a system of water wheels of the Pelton type, each direct connected to the particular machine for which it furnishes power.

The water is collected from the headwaters of the Stanislaus and Mokelumne rivers, supplemented during the dry seasons by large storage reservoirs some sixty miles northeast from the town, and brought down, by a combined system of creek channels and ditches, to this dam, where it was designed to make a sort of regulating reservoir, holding some six days' supply, by throwing a wall across the outlet of a basin of about 20 acres extent on San Domingo Creek.

I do not know that any detail plans for the structure were ever made, and apparently no lines were ever laid out for its construction; if they were, no attention was paid to them during the progress of the work. The plan, therefore, is only an approximation to the lines of the completed structure, which was irregular and wavy in outline.

In general, the dam started at the east end, with a curve convex up stream of about 200 ft. radius and about 120 ft. in length, reversing to a second curve convex down-stream, with a radius of about 100 ft., and continuing thence in a straight wall about 100 ft.; thence at a slight angle, the wall was continued 100 ft. or more by an earth embankment.

The masonry was a fair to poor grade of uncoursed rubble, made from rock quarried at the site of the dam and laid in cement mortar of White's English Portland, mixed 1 to 3, or about that. The dam, as I was informed by men on the work, was originally designed to be 45 or 46 ft. in height, and was given a base of 35 ft. After carrying up the wall for 20 ft. this thickness was abruptly reduced from 21 to 13 ft., and the wall then carried up to a maximum height of 52 ft. above the foundations, or 6 ft. higher than originally designed, where it was finished with a top thickness nominally of 3 ft., but which ranged all the way from 30 to 42 ins. After completion, the down-stream face was covered with a coat of cement mortar of unknown thickness, applied by pouring or ramming it between the face of the wall and a temporary plank mold or casing.

The up-stream face, which was vertical, was left without such finish. Near the center of the first curve and about over the creek channel two gateways were left in the dam at about the elevation of the offset in the thickness of the wall. Each of these was between 3 and 4 ft. sq., and was closed by a sliding wooden gate operated by a rack on top of the wall. One gate discharged direct into the channel of the creek, the other into a wooden flume, terminating in a ditch which led the water to a small distributing basin three miles distant and at the head of the pressure pipe.

In the straight stretch of wall was the waste weir, which was 10 ft. long and 3 ft. below the crest of the dam. In this was a wooden apron projecting several feet beyond the down-stream face of the wall and discharging any overflow with a clear fall of some 15 to 20 ft. on the bedrock at the toe of the wall. Along the up-stream side of the straight wall, and the western curve, an embankment of clay, lying at a slope of 6 or 8 to 1, extended perhaps a quarter of the way up the up-stream face, and showed signs of having settled from a much steeper and higher position.

At the junction of the second curve with the straight wall, and on the lower side of the dam, was a pile of loose dry rock, perhaps 20 ft. long and 10 ft. wide, and extending nearly to the top of the wall at the point marked D on the plan, which the foreman told me had been placed there to prevent a threatened failure of that part of the wall. Just west of this buttress were several inclined braces (5 or 6) made of logs, their lower ends set on the bedrock and the upper ends bearing against the down-stream face, the logs being 24 to 30 ins. in diameter, set at an angle of about 45°, and nearly covered with dirt and debris.

Just west of the waste weir was a ragged hole in the bedrock, extending from the wall, 20 to 25 ft. down stream, with a width of some 20 ft., and a depth of 10 or 12 ft. This, I was told, was caused by the bedrock washing out from under the wall on two occasions when it had been attempted to fill the reservoir; whether the hole extended above the wall it was impossible to tell, since several teams were then at work building an earth embankment on the upper face. This was nearly level with the top of the wall, and being of a rather stiff clay, stood at an angle of 45°, or even steeper, and the foreman assured me it was "so compacted by the feet of the horses and wheels of scrapers that it would not settle at all on the admission of water to the reservoir." A short distance above the wall at the point marked H some workmen were digging a hole which the foreman told me "was where he had been trying to dig out a cottonwood stump, but the blamed roots run clear under the wall, and he could not get them." The construction, I am informed, was carried on under the direct supervision of the superintendent of the company, and I am unable to find that any engineer laid out, planned, supervised, or gave any advice on the work.

The coroner's jury, empanelled in the town, which is entirely dependent on the company owning the dam, returned a verdict of "accidental death," and by implication censured the victim for "carelessness" in being in his garden, where the flood could get him.

As the same company has many thousand acre-feet of water stored for a summer's supply of power in the high Sierras, part of it behind a dam which I am credibly informed fell down twice before it was successfully filled, a pleasing line of speculation is offered to life insurance companies doing business in the valleys below.

A curious sidelight seems also to be thrown on the kind of supervision exercised over California storage reservoirs. Respectfully, N. C. R.

Coulterville, Cal., April 24, 1895.

(The clipping enclosed with this letter states that the break occurred at the "eastern corner" of the dam, starting "at about the center of the wall," and that "100 ft. of the bank was washed away." It also states that the cost of the dam was $52,000, and that the man who lost his life did so in attempting to secure some valuables in his house instead of hurrying out of danger. The failure was noted briefly in our issue of April 18, 1895.—Ed.)

EXPERIENCE WITH AUSTRALIAN HARDWOOD PAVEMENTS.

The vestry of St. Martin-in-the-Fields, London, sends in, through its surveyor, Mr. Chas. Mason, A. M. I. C. E., the following report on the use of hardwood pavements: About 400 sq. yds. of Jarrah wood were laid in the Strand in 1889. The blocks were 9 × 3 × 5 ins., laid with a ⅝-in. joint, grouted with cement and sand; they adjoined 9 × 3 × 6-in. yellow deal blocks, and the hardwood was laid with an inch of sand to make up the difference in height. This Jarrah pavement was taken up in 1893, when the whole Strand was repaved. It was found that the hardwood had worn down in four years to 4 ins., while the adjoining deal in the same time had been worn down to an average of 3½ ins., the relative wear being as 2 to 5. The wear was excessive at the bus-stand in front of Charing Cross Post Office. At this point the 6-in. deal blocks wore out beyond repair in 12 months, and they were replaced by Jarrah wood in 1890. When the latter was taken up in 1893, it was found that they were worn an average of ¾ in. per annum, or in the proportion of 1 to 5 as compared with the yellow deal. Hardwood was again put down at this place in 1893, in 6-in. blocks, and an examination in March, 1895, shows an average wear of 0.20 in. per annum.

On Long-Acre 400 sq. yds. of Jarrah pavement were laid in October, 1893, where the omnibuses pull up. This wood has now (March, 1895) worn from 5 ins. to 4.76 ins., or at the rate of 0.17 in. per annum. In Green St. a section of 4-in. Karri blocks was laid with close joints, grouted with a mixture of pitch, tar and creosote oil, and the blocks dipped in same. The wear to the present time is almost imperceptible.

Thirty-six other London vestries and parishes have also tried Australian hardwood pavements, and their replies to queries are given in tabular form. The woods used include Jarrah, Karri, Blue-gum and Stringy-bark in 4 to 5-in. depths of block, with close joints. The time has been too short to allow satisfactory replies as to relative wear. The total cost, exclusive of foundation, is from $2.75 to $3.75 per sq. yd. Only four parties complain of slipperiness, and all combine to say that cleaning is easier than on yellow deal pavement. It has been used on gradients of 1 in 34 and 1 in 30.

The general conclusions of Mr. Mason were as follows: In his parish the hardwood costs $2.75 per yard, exclusive of foundation, as against $1.68 for the creosoted deal. In comparing cost with relative wear and tear, he estimates that a hardwood pavement at $2.75, lasting 12½ years, is equivalent to a deal pavement at $1.68 lasting eight years, which is a good life for the ordinary wood pavement in his parish. He finds, in St. Pancras Parish, one case of hardwood that wore down ⅛ in against ¾ in. for deal, or as 6 to 1 in favor of hardwood. He believes that the Jarrah wood in the Strand, which showed a relative wear of 2 to 5 in

four years, would have stood better if it had been laid directly on the concrete instead of on sand. He recommends the Jarrah and Karri woods, both of the eucalyptus family, for further use, as these have been tested in London.

A paper detailing experience with these Australian woods was recently read before the Institution of Civil Engineers by Mr. W. Alexander Smith, of Sydney, New South Wales. The blocks used were from the various kinds of the eucalyptus tree, known as tallow-wood, and mahogany, black butt, etc. These blocks were dipped twice in boiling tar and drained for two days, and were then set on a 9-in. course of concrete. It was especially worthy of note that in removing some old blocks of these and other timbers it was observed that while an asphalt joint acted as a preservative of the wood, a cement joint was very injurious, and dry-rot had set in in all cases where the cement touched the wood. A microscopical examination showed no fungoid growth, and it was concluded that the decomposition resulted from chemical action—the oxygen in the cement combining with the carbon in the wood to form carbonic acid gas.

The writer then makes a comparison as follows:—Taking the average life of the deal blocks used in many parts of London as seven years before total renewal is necessary; and assuming that the cost of laying the blocks, exclusive of foundation, is $1.32 per sq. yd. and the annual cost of maintenance is 10 cts. per sq. yd.; then the cost of a wood-paved roadway calculated to sustain a daily traffic of 1,200 tons per yard width of roadway for 21 years would be $4.26 per sq. yd.

In Sydney, the cost of similar work, using Australian hardwoods and exclusive of foundations, is only $2.34 per sq. yd. for close-jointed paving and $2.56 for a pavement with ¼ or ⅜-in. asphalt joints. The author says that soft wood blocks under a very heavy traffic will wear down as much as 2 ins. or more; they must be renewed every seven years, and for the last 18 months previous to each renewal the smooth and regular surface is practically destroyed by the wear. He claims for the Australian hardwood a life of 21 years, and says that in Sydney a hardwood paving which has been down on one of the busiest streets for 13 years shows a wear of only 9-16 in. and is still in perfect preservation, promising another 10 years of useful life. A good and heavy concrete foundation and close joints, however, are necessary conditions of long service.

FINDING MOMENT OF INERTIA OF ROLLED SECTIONS OF VARYING SIZE.

By J. W. Schaub, M. Am. Soc. C. E.

In all of the handbooks published in this country by the various rolling mills, the elements of the shapes are given for the minimum sections only. When it becomes necessary to find the elements of the increased sections, the computer must determine them by the well known principles of mechanics. The term "elements of a shape" is here used to designate the moment of inertia, moment of resistance, etc.

If the elements are given for any minimum section, the increase in its elements can be expressed in terms of the corresponding increase in weight per lineal foot by a coefficient. As the writer has determined these coefficients for all beams and channels, and as these are applicable to all shapes in general, he presents them herewith for the benefit of the profession. For all shapes, such as beams, channels, etc., which are increased in raising the rolls by a rectangle,

Let I^1 denote increase in moment of inertia.
" R^1 " " " " " " resistance.
" W^1 " " " " weight per lineal foot.
" b " " " thickness of web.
" h " depth of the shape.

When the neutral axis is perpendicular to the web at the center, we have:

$$I^1 = \frac{bh^3}{12}, \text{ and } R^1 = \frac{bh^2}{6};$$

$$W^1 = b \times h \times \frac{10}{3} + 2\% \text{ for steel} = bh \times 3.4;$$

$$R^1 = \frac{h}{3.4} \times \frac{W^1}{6} = h \times 0.049 \times W^1.$$

From the last equation it is evident that the relation between R^1 and W^1 can be expressed graphically by a straight line.

The diagram submitted herewith gives the coefficients h × 0.049 for all steel beams and channels from 3 ins. to 24 ins. deep. The increase in the moment of resistance corresponding to an increase in the weight per lineal foot, can be read off from the diagram.

When the neutral axis is coincident with the web, the relation between R^1 and W^1 varies with the shapes rolled by the different makers. However, when it becomes necessary to find the change

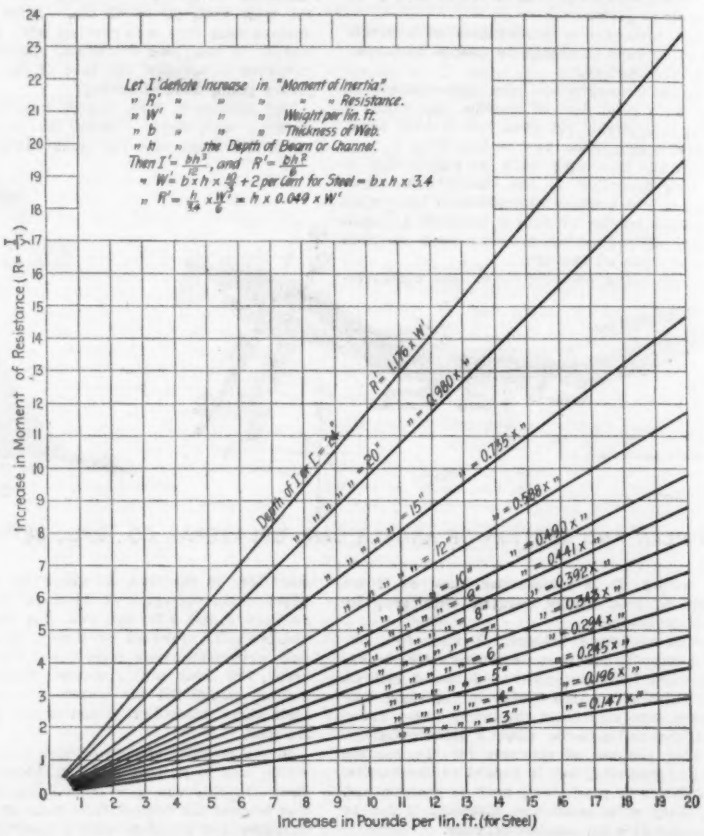

Let I' denote Increase in "Moment of Inertia".
" R' " " " " " Resistance.
" W' " " " Weight per lin. ft.
" b " " " Thickness of Web.
" h " the Depth of Beam or Channel.
Then I' = bh³/12, and R' = bh²/6
" W' = b x h x 10/3 + 2 per cent for Steel = b x h x 3.4
" R' = h/3.4 x W'/6 = h x 0.049 x W'
R' = 1.176 x W'
" = 0.980 x "
" = 0.735 x "
" = 0.588 x "
" = 0.490 x "
" = 0.441 x "
" = 0.392 x "
" = 0.343 x "
" = 0.294 x "
" = 0.245 x "
" = 0.196 x "
" = 0.147 x "
Depth of I' = 24"
" " " = 20"
" " " = 15"
" " " = 12"
" " " = 10"
" " " = 9"
" " " = 8"
" " " = 7"
" " " = 6"
" " " = 5"
" " " = 4"
" " " = 3"
Increase in Moment of Resistance (R = I/y)
Increase in Pounds per lin. ft. (for Steel)

DIAGRAM SHOWING INCREASE IN MOMENTS OF RESISTANCE WITH INCREASE IN WEIGHT PER LINEAL FOOT OF STEEL I-BEAMS, CHANNELS AND SHAPES HAVING THE NEUTRAL AXIS PERPENDICULAR TO THE WEB AT THE CENTER; By J. W. Schaub, M. Am. Soc. C. E.

in the value of the moment of resistance for this case, it is sufficiently accurate to assume that it increases directly with the weight per lineal foot.

For all shapes rolled as angles, Z-bars, etc., it is sufficiently accurate to assume that the moment of resistance increases directly with the weight per lineal foot.

Having found the moment of resistance for any shape, the moment of inertia and the radius of gyration can be readily obtained.

COST OF DREDGING IN THE LOWER DANUBE.*

By Charles H. L. Kuehl, M. Inst. C. E.

In a previous paper the author gave some particulars of the works of improvement on the Lower Danube then being carried out by the European Commission, under the direction of Sir Charles A. Hartley, K. C. M. G., M. Inst. C. E. The methods of dredging in use were described in that paper, and the cost of dredging was given, as based on the work done up to that time. The table now presented gives the cost of the work which has been done in the years 1890 to 1893, inclusive. It was all effected in making a new cut between 8½ and 18 miles from the Sulina mouth of the river.

The total quantity dredged in these four seasons amounts to 5,926,136 cu. m., or 7,751,517 cu. yds., and the average cost has been 0.286 franc per cu. m., or 2 1-5d. (5 cts.) per cu. yd. This includes transport by hopper-barges for such part of the stuff as was disposed of in that way, but does not include the interest on capital outlay, nor any allowance for depreciation of plant or insurance.

The dredgers work night and day during the working season in two shifts, from Monday at 6 a. m. to Sunday at 6 a. m. The stuff dredged varies from very hard clay and heavy sea-sand to light silt and fine sand. When using the mud-pump the quantity delivered per week varied from 10,000 to 40,000 cu. m., according to the nature of the stuff. When very hard clay is met with, too stiff for the mud-pump, hopper-barges are brought alongside. The heavy, fine sea-sand could only be pumped with great difficulty, as it settled in the floating pipe, causing it to sink. It was found, however, that by increasing the speed of the pumps from 225 to 275 revolutions per minute, almost any material that was met could be dealt with.

The following are the vessels to whose work the table refers:

(1) "Sulina" dredger.—115 ft. long, 25 ft. beam, 10 ft. 9 ins. depth, with single, side-lever, low-pressure engine of 40 nominal HP. Cost, £14,700.

* From selected papers of the Institution of Civil Engineers.

European Commission of the Danube. Cost of Dredging in the 8½ to 18-Mile Cutting, 1890-1893.

Name of vessel.	Quantity dredged in cu. m.	Working expenses in francs per cu. m. Coal and stores.	Working expenses in francs per cu. m. Crew and wages.	Repairs to vessel and machinery in francs per cu. m. Stores.	Repairs to vessel and machinery in francs per cu. m. Labor.	Total cost. Francs per cu. m.	Total cost. Pence per cu. yd.
"Sulina" dredger[1]	1,310,836	0.08123	0.12623	0.33500	0.05617	0.29713	2.181
"Delta" dredger[2]	2,634,946	0.06584	0.07777	0.03337	0.03480	0.21178	1.554
"Sir Charles Hartley" dredger[3]	1,980,354	0.05153	0.07302	0.03732	0.02433	0.18620	1.367
	Quantity transported.						
Tug-boats and hopper-barges[4]	1,004,084	0.08823	0.05730	0.00725	0.12413	0.27691	2.033

Note.—No allowance is made in the above figures for interest, depreciation or insurance.
[1]Dredging into hopper-barges, and also into long shoot, delivering on shore.
[2]Dredging with mud-pump, and occasionally into hopper-barges.
[3] " " " " " " " "
[4]Average lead 3 nautical miles.

(2) "Delta" dredger.—124 ft. long, 28 ft. beam, 10 ft. depth, with compound, surface-condensing direct-acting inverted engine of 180 I. HP. Cost, £16,405.

(3) "Sir Charles Hartley" dredger.—124 ft. long, 28 ft. beam, 10 ft. depth, 250 I. HP. Cost, £19,440.

(4) Tug-boats and Hopper-barges.—Cost, £16,495.

The "Sulina" works, as a rule, with hopper-barges. She was fitted in 1891 with a long shoot delivering 130 ft. from the center line of the vessel.

The "Delta" and "Sir Charles Hartley" work, as a rule, with the mud-pump on Burt's system, and only occasionally with hopper-barges.

LOCKED TENTS FOR ENGINEERS AND SURVEYORS.

A tent-flap and fastening, intended especially for the use and convenience of engineers and surveyors living in tents while engaged in field work, have been recently patented by Mr. Jas. J. Rinn, of San Francisco, Cal. The purpose of the invention is to provide means by which the entrance flaps of a tent may be closed perfectly tight against wind and rain,

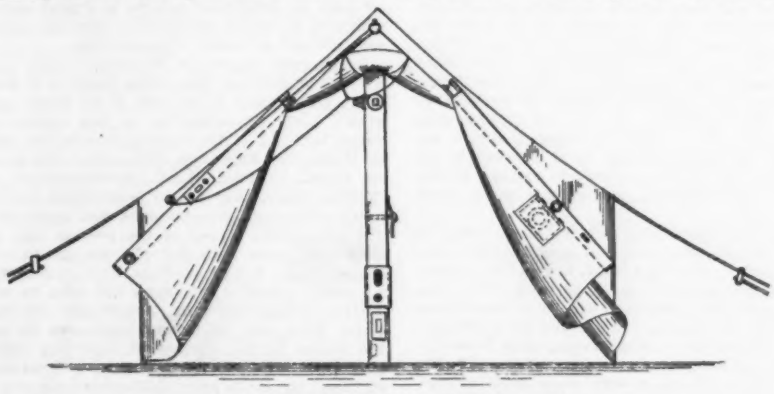


FIG. 1. FRONT VIEW OF RINN TENT.

and yet be opened and closed as easily and quickly as a house-door, and also be locked when the owners are absent.

To accomplish this end, a rigid strip is fastened in the edge of one or both of the entrance flaps, and means are provided for securing these strips to the tent-pole, as indicated in Fig. 1. Either one flap or both can be converted into doors, as required. The strips are connected to the upper end of the tent-pole by a universal, yet detachable, joint (Fig. 2), in such manner that the strip and its flap can be swung aside, merely providing an entrance; or both strips can be detached from the tent-pole and a wide opening made, as shown in Fig. 1. The horizontal slit in the canvas required for this purpose is opened or closed by cords provided, and a hood closes this opening against wind and rain.

Locking the flap of a canvas tent may seem at first thought a useless precaution against thieves, but such a provision is nevertheless a convenience, and will, in the majority of cases, prevent the entrance of meddlesome or prying individuals, who, while they would not hesitate to untie the ordinary tent fastenings, would not venture to break a lock or cut a hole in the canvas.

To fasten the tent, a mortised bolt is firmly secured on the rigid strip at about the height of a door-latch, and to the front of the tent-pole is fastened a locking or latching device. In the side of the lock is a push-button, always accessible from the inside and reached from the outside by inserting the finger in a slit provided in the canvas. The insertion of a pin into this lock makes it secure against entrance from without, and by using a padlock on a hasp, the rigid strip can be locked to the tent-pole when the owners of the tent are absent.

Similar means are provided for securing the tent when both flaps are to be used as doors. These appliances may be adapted to both ends of the tent, and by an ingenious arrangement Mr. Rinn provides for the use of mosquito or fly nets in connection with these doors. Among other advantages claimed by the inventor is that of greater durability in the tent itself, as the rigid strips and general arrangement prevent the usual beating and wearing of the flaps in windy weather. The tent is as easily transported as any other form of tent, as the strips are readily removed from the edge pockets in the flaps, and are then latched to the tent-pole. Another device of the same inventor applies to round tents and to those having no tent-pole at the entrance. Tents of this description have been successfully used for several years in surveying and railway work in the far West, and have proved their convenience and advantages over other types.

The various fastenings are not shown in detail, but the inspection of a set brought to this office is sufficient warrant for saying that they are simple, strong and well designed for the several uses for which they are employed. Mr. Rinn's New York address is 232 East 13th St.

STUDIES FOR A WATER-WORKS INTAKE AT BUFFALO.

One of the most interesting features connected with the water-works which draw their supply from lakes or rivers subject to the formation of ice is the intake used. In trying to settle upon the form of a new intake to be built for the city of Buffalo, Mr. Edw. B. Guthrie, Assistant Chief Engineer of the Buffalo Board of Public Works, inspected the water tunnels and intakes of Chicago, Milwaukee, Cleveland and Erie. The visit was made in the latter part of January, 1895. Shortly after, Mr. Guthrie made a report on this subject, the conclusions of which are given in full below.

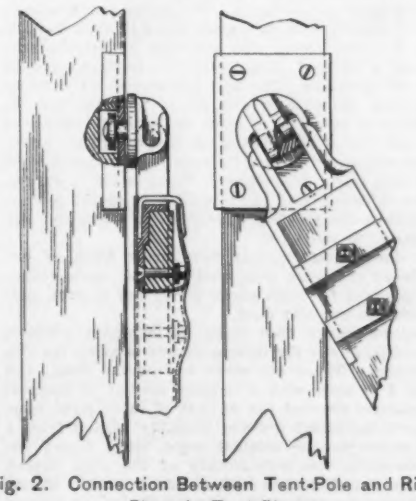


Fig. 2. Connection Between Tent-Pole and Rigid Piece in Tent Flap.

In his report Mr. Guthrie first stated what he saw and learned on his trip. When the Chicago cribs were visited the temperature was zero. At the two-mile crib 19 men were at work keeping the four 4×5-ft. ports clear of ice. A tug was so stationed as to cause, by means of her wheel, a current out from the channel between the crib and a breakwater which surrounds all but 30 ft. of the former. Men were poling ice into this current. Chains laid through the crib ports are dragged back and forth to keep the ports clear, and in addition water at 140 lbs. pressure (probably at the pumps) was being played through hose to wash the slush and ice through three of the ports into the well of the crib. From the well some of the ice is scooped out by nets and wire baskets, but most of it, the report states, goes into the tunnel. Some figures in relation to this and the other intakes are given in the table.

At the four-mile crib the ice gives little trouble, Mr. Guthrie states. This he attributes to the large port and well areas and the depth of the ports below water level. Ice here is, or may be, lifted in wire baskets, hoisted by a steam engine, run on an overhead trolley, and finally dumped into the lake.

At the present Milwaukee submerged intake a 50-HP. boiler has been used to generate steam, which is conveyed down a 2-in. pipe to the intake. It is stated that a 10-minute application of steam stops all trouble from ice here.

At Cleveland the removal of a wooden cap, placed slightly above the top of the tunnel shaft in the crib, has been followed with a cessation of most of the trouble caused by ice. Only one man is kept on the crib. At Erie one man with a pike pole tends to the ice. But here the crib is in a land-locked harbor, "inside the pier head line and on the shore side of the harbor."

The conclusions drawn by Mr. Guthrie are as follows:

The crib form of intake, by which I mean a structure rising above the water's surface, as distinguished from the submerged type, was first used 30 years ago in the original Chicago tunnel. This form has been adhered to there, copied at Cleveland, Buffalo and possibly at other lake cities, with modifications. In adopting it there was no experience governing the methods of arrangement or the effect of ice, therefore theory alone guided its construction. It was built quite heavy to resist wave and ice action, with ports at a depth supposed to be sufficient to keep ice out of the well and the tunnel. On account of its size, it has been expensive, costing at Chicago from $150,000 on the original tunnel to $376,000 on the four-mile tunnel. This form at Cleveland cost $109,000, and at Buffalo $100,000. As the consumption of water increased trouble began, not only with the floating ice, but more seriously with anchor and slush ice, which clogged up the ports or was carried into the wells and tunnels by the greater inflowing current. This has been a difficulty requiring not only great care but expense to overcome. In the later cribs the size has been increased, the ports made more numerous, deeper and of larger area. If water could be drawn at sufficient depth and through sufficiently large area, and the inflowing current reduced to a few inches per second, it is fair to presume there would be little or no trouble from ice. Acting upon this theory, the submerged intake, constructed as at Milwaukee, has been devised. This type, by the way, has been in successful use at Toronto. It is possible to so arrange this that the tunnel can be controlled, though not so readily as with the crib type. The main points to be observed in its construction are, that in a navigable channel it should be in water deep enough to present no obstacle to navigation, far enough above the bottom to have no objectionable matter carried into it, and with large inlet area to reduce the current to a few inches per second. It is my opinion that the submerged type is the best, for the following reasons:

(1) By it water can be supplied from the purest stratum. (2) It is the least expensive, both in first cost and in maintenance. (3) I believe it will greatly diminish, if not prevent, stoppage from ice.

The greatest objection to the crib type, aside from first cost, is the fact that it evidently increases, or even causes, the danger from ice, this varying inversely with the size of the crib, wells and ports, requiring them to be large and deep. Anchor or needle ice causes the most trouble at the lake cities, as testimony from each place visited and deduced from recorded accounts shows. This ice forms in small particles, combines in large masses when adhering to the cold walls of ports or other portions of the crib, and, unless removed in time, closes the openings. The theory of formation of this, as given by J. B. Francis, Past Pres. Am. Soc. C. E. (see Transactions, Vol. XVI., p. 171, and Vol. X., p. 192), is as follows:

When the temperature of the water is at freezing and that of the atmosphere is below freezing, ice forms at the surface and becomes needle or anchor ice, as it is carried down by a descending current. It is also necessary for its formation that the water up stream should be open, uncovered with ice.

If this theory is true, and it seems to be from concurrent testimony, a reduction in the velocity of an inflowing current, the quantity remaining the same, would diminish this trouble. The most obvious way to accomplish this is to make inlets of large combined area compared with that of the tunnel to be supplied. The next would be to deepen the inlets or ports so the surface water would have further to travel before entering them. I have made calculations, given in

the accompanying table, showing the comparison between the areas of the ports, tunnels, and the velocities through each, respectively, based on the full theoretical capacities of the tunnels, though these are not reached at any of the cities, excepting Buffalo. These calculations show that the ratio between the ports and tunnel areas at Buffalo and the original Chicago crib is as 1.05 to 1, or approximately of the same area, and at both places there has been considerable trouble with ice. The velocities through the ports at Chicago would be 3.85 ft. per sec., based on the full tunnel capacity, and in Buffalo, 5.9 ft. per sec., or four miles per hour. The last two cribs built in Chicago have port areas from 3 to 3.75 times the tunnel area, and respective velocities of 1.44 and 1.06 ft. per sec. In other words, these velocities are only ¼ to ⅓ of those in the earliest cribs.

To obviate ice at the present intake I advise that the ports be enlarged to at least three times the tunnel's area, in a general way, as proposed in 1894; or, possibly better, converted into a submerged intake by removing the whole down-stream end, leaving the nose for up-stream protection. If neither of the above plans are carried out, my observation of the efficiency of steam at Milwaukee leads me to advise, as recommended by Mr. Knapp and myself, placing a boiler at the inlet pier. The conditions at Milwaukee are different and the volume of water flowing into the intake but one-fourth of that here, yet I believe that steam would prove quite valuable in cutting away and preventing the stoppage from ice.

Comparison of Areas and Velocities of the Water Tunnels and Ports at Chicago, Cleveland, Milwaukee and Buffalo.

	No.	Size, ft.	Million gallons 24 hours.	Cu. ft. per sec.	Combined area, sq. ft.	Velocities. Ft. per sec.	Miles per hour.	Ratio, area ports to tunnels.
Chicago:								
2-mile tunnels..		7	100	154	.....	4	2.75	....
		5	50	77	58.11	4	2.75	....
Crib ports.....	3	4x5	..	..	60.00	3.85	2.70	1.03
4-mile tunnel...		8	100	216	50.27	4	2.75	....
Crib ports.....	6	5x5	..	..	150.00	1.44	1.00	2.98
Lake View tun.		6	72	111	28.27	4	2.75	....
Crib ports.....	6	5x3.5	..	..	105.00	1.06	.75	3.75
Cleveland:								
Tunnels		7	100	154	.....	4	2.75	....
		5	50	77	58.11	4	2.75	....
Crib ports.....	5	3x3	..	..	.....	2.8	1.9	1.4
	3	5x2.5	..	..	82.50	2.8	1.9	1.4
Milwaukee:								
Tunnel		7	..	..	38.48	...	...	....
Crib ports.....	4	5x3.5	..	..	70.00	...	...	1.81
Buffalo:								
Tunnel		6	115	177	28.27	6.25	4.25	....
Crib ports.....	2	5x3	..	..	30.00	5.9	4.00	1.06

The two-mile tunnel and crib at Chicago were the first built, and have been greatly troubled with ice. At the Chicago four-mile crib there has been but little ice trouble; tunnel operated to but one-third its capacity. The Cleveland crib and tunnel are also operated to but one-third of their capacity. The Milwaukee crib is not in use, and will be for emergencies only. The Buffalo tunnel worked at full capacity, and there was trouble with ice, but not as much as at Chicago.

To summarize the foregoing, I recommend: (1) The submerged type of intake in place of a crib on a new supply, as being less expensive and less liable to cause stoppage with ice. (2) An enlargement of the present intake, possibly converting it into the submerged form for reasons given, and if this is not done, that steam be tried at the inlet.

STEAM PIPES FOR MARINE ENGINES.*

By Mr. J. T. Milton.

The importance of having reliable steam pipes on board vessels cannot be overestimated. By far the greater number of steam pipes have been and are being made of copper, but of late wrought iron has, in a few cases, been used, as on the Cunard steamers "Campania" and "Lucania." There are 18 Liverpool steamers on which cast iron steam pipes (and cast iron feed pipes) have been in use for 7 to 25 years.

The almost invariable use of copper for steam pipes for so many years has produced the general impression that it is the only suitable material. It, no doubt, was originally selected on account of its non-liability to corrosion on one hand, and of its great ductility on the other. As regards corrosion, the almost invariable use of cast iron for stop-valve chests and safety-valve chests, as well as its frequent use for T-pieces connecting copper steam pipes, and its invariable use for the slide chests and doors of the high-pressure cylinders, show that cast iron, at any rate, can be used, without misgivings on this point, in parts which, like steam pipes, are always subjected to the full pressure of the steam. The experience with the "Campania" and the "Lucania," so far as it has gone, and also several other large vessels, shows that wrought iron pipes also give no trouble in this respect. It was, therefore, no doubt, mainly owing to the ductility of copper that it obtained, and has since maintained, the preference over other materials for steam pipes.

Steam pipes have to withstand considerable changes of temperature, and their length is consequently liable to continual alterations. Their attachment to the engine may be liable to slight alteration in position, owing to the working or vibration of the engines or vessel; while those to the boilers are also liable to small displacements, due to the contraction or expansion of the boilers from variations of temperatures. All these changes are generally taken up or provided for by the deformation of easy bends in the pipes, or by expansion stuffing boxes where the pipes are straight.

Whatever forces are necessary to produce the deformation of a length of steam pipes necessary to allow for the expansion of the pipes, or for any possible working of the engines in the vessel, these forces have to be withstood by the necks of the stop-valve chests or their attachments to the boilers and to the engines. In the case of pipes of small diameters and small thickness, if the bends are easy, a moderate force may be sufficient; but if the pipes are thicker, even if the diameters and the shapes of the bends are the same, the forces required to be borne by the attachments will increase in proportion to the thickness. The same thing holds good of the flange joints between the different lengths of pipe. These have to sustain the forces brought on the end attachments, and it might, therefore, very well happen that a design suitable for steam pressure of 60 lbs. may be altogether unfit for 180 lbs., solely on account of the greater thickness required, making the pipes more rigid.

The advance of engineering of late has not only increased the steam pressures used (and therefore the temperatures also), but engines are, in general, of much greater size and power than those used years ago. The steam pipes now, therefore, are, as a rule, larger in diameter, much thicker, and are subject to greater changes of temperature and expansion than formerly. These all make the pipes so much stiffer, or more rigid, that with many pipes, even when made of copper, their rigidity is so great that their yielding or altering form cannot be relied upon to relieve expansion strains, which have, therefore, to be provided for in the same way as they would need to be if the pipes were made of cast iron.

Concurrently with the trouble of providing for expansion, etc., with thick and large pipes, there arises also a difficulty in manufacturing them. The usual method for pipes of large diameter is to make them (both bends and straights) from copper sheets, the straights, except in very large pipes, having one seam along the entire length, the bends having two seams along the sides, the saddle and back pieces being each worked up from one sheet. The seams are invariably brazed, the edges of the copper being thinned down to form a scarf. Now, the difficulty of satisfactorily brazing a joint of this description increases rapidly with the thickness. The heat has necessarily to be applied from the outside, and has to pass through the thickness of the metal to reach the brazing solder, and thus the risk of overheating the copper on the outside, and consequently burning it, is much greater with thick than with fairly thin copper. There is also a further danger of deoxidizing the copper, both in the brazing and also in the previous annealings to which the copper has to be subjected.

All these considerations have made some of our prominent engineers look with disfavor upon copper as a material for large steam pipes, and to turn their attention to iron and steel.

Endeavors have been made to introduce seamless pipes of large size for these purposes to avoid the risk of brazing. These are made by several firms, and lately, I believe, with a certain amount of success; but amongst some of the earliest of those made some serious longitudinal defects, probably arising from a local defect in the original ingot being drawn out lengthwise in the manufacture of the pipe, caused them to be looked upon with a certain amount of suspicion, besides which the great difficulty of making satisfactory bends with these large pipes has no doubt had some influence in preventing their more general use.

While treating of bending copper pipes, it may be well to mention that the usual practice is to make bends from tubes one gage thicker than straight pipes of the same diameter. This is, no doubt, correct practice, so long as the radius of the bend does not fall below a certain value, depending on the diameter and thickness of the pipes; but where sharp bends are made from bent tubes, a greater thickness ought to be provided. It is often assumed that in bending pipes the axis of the tube does not lengthen, and that the material of the saddle of the pipe becomes compressed to an amount about equal to the extension at the back of the bend. This is not the case. The compression of the material is not very great, and the pipe bends by extending not only at the back of the bend, but also along the sides; and if it be remembered that the thinning of the metal must be proportional to the extension, it will be found that one gage thicker is in many instances scarcely able to provide for this.

The method of manufacturing the Elmore copper pipes has been frequently described, and it has been claimed that it renders the probability of their containing any latent defect very remote.

From tensile tests, however, it appears that Elmore copper even when hard has much extension, but that it commences to elongate at much less stress than annealed ordinary copper; while, when annealed, its behavior as to ultimate strength and extension is very similar to that of good commercial copper, but it appears to commence to elongate at somewhat lower stresses than the latter.

Engineers generally purchase their copper sheets or tubes without subjecting them to rigid tests, relying upon the reputation of the makers for supplying a good article, and not troubling about the chemical composition, etc., so long as it is found to work well. In view of the great ductility of copper, the working of even an indifferent sample of copper may not be sufficient to detect its quality, especially when made into straight or nearly straight pipes.

Commercial copper is practically never pure, the amount of different impurities found in it being probably greater than in the case of any other metal commonly used. Information on this question can be found in No. 2 of the Transactions of the Institution of Mechanical Engineers, 1893, where two papers will be found, by Prof. W. C. Roberts-Austen and Mr. William Dean. An opinion is generally held by locomotive engineers, coppersmiths, and many others that the commercial copper of the present day, although chemically purer than that of years ago, is inferior in respect to its lasting qualities, both as regards ability to resist corrosive influences and also to withstand fatigue without cracking. Accordingly, for some purposes, what may be termed impurities are added to the copper for the purpose of improving some of its properties. The papers referred to, and the discussion on them, appear to show that arsenic up to a proportion of ½% is certainly not injurious, and is probably beneficial, improving both the tensile strength and ductility of the copper. On the other hand, bismuth is objectionable, even small quantities, such as 0.1%, being sufficient to make the metal absolutely unreliable when heated above the boiling point of water. A small quantity of lead, say, under 0.1%, does not appear to be objectionable, but large quantities are not desirable; on the other hand, it appears that nickel and silver are not detrimental, the samples quoted by Mr. Dean as containing the largest proportions of these elements having given satisfactory results in use.

It has been stated that the tensile strength and ductility of copper vary according to its composition, but with the same mixture of metal they vary very much more with the mechanical treatment it undergoes. If properly annealed, its tensile strength is comparatively low, and its ductility is high. In comparing the qualities of copper, therefore, it is necessary to fix the standard as being thoroughly annealed. To show the effect of annealing and of work, the following tests recently made may be quoted. A copper tube was drawn in one operation from 3 w.g. to 11 w.g. (a very excessive draw, more than doubling its length). Its tensile strength when drawn was 24.38 tons per sq. in., but its elongation was only 3.1% in 4 ins. After annealing (or possibly only partial annealing) its tensile strength was 16.66 tons per sq. in., and its elongation was 44% in 4 ins. A good average result with annealed copper is 14 tons per sq. in., and 40 to 45% elongation in 4 ins.

That copper for large steam pipes is now being looked upon with some distrust is evidenced by the Admiralty having such pipes bound round with wire, whilst in mercantile practice some firms put iron bands round the pipes every few inches, and in some cases the pipes are lapped with fine steel wire ropes. Turning our attention to other materials suitable for steam pipes, we find, practically, only three—viz., cast iron, wrought iron, and mild steel.

Cast iron has the advantage that it can be made in any shape, straight or bent, and that tees or junctions can be made of it. On the other hand, if the pipes are of the same strength as wrought iron or steel, they are much heavier.

Wrought iron and steel may both be made with a lap-welded joint, but whereas welds in iron are apparently looked upon as trustworthy after a severe hydraulic test, those in steel do not appear to have the same confidence reposed in them, as they generally have a riveted butt strap fitted over them. Apparently, therefore, iron pipes are preferable to steel, unless the latter are made seamless.

With pipes of either iron or steel, manufacturing conditions appear to require them to be of such a

* Abstract of a paper read before the Institution of Naval Architects of Great Britain.

thickness that either has a very large margin of strength compared with the pressures now being used, or even with those higher pressures to which marine engineering appears to be tending, so that there is no advantage in this respect in using steel rather than iron.

The question of flanges for iron pipes is important. Most of those hitherto used have had forged iron flanges screwed on, riveted over on the face of the flange, but flanges are now being electrically welded to the pipes in some cases, and welded by machine hammers in others, these plans apparently giving sound results without the chance of leakage which screwed flanges might develop.

Regarding provision for expansion of pipes, whether of copper, iron, or steel, a point sometimes lost sight of is that it is not sufficient to provide a faucet joint in a straight length of pipe, but provision must also be made to anchor the ends of the length of pipe for the expansion of which provision has to be made, and so compel the movement of expansion to take place in the part provided for it, otherwise the end pressure on the pipes, amounting to several tons in all but the smallest pipes, will cause the joint to slide in the wrong direction. This has occasionally been overlooked in pipe designs. It is always difficult to provide for the expansion of large bends without producing excessive strains, so that, as far as possible, pipes should be made straight.

The only other point to which reference will be drawn is that of providing means of draining steam pipes. More than one fatal accident has been thought to be due to the presence of water in the pipes. In cases where it is the practice to always raise steam in all the boilers simultaneously, the stop valves on the boilers, if opened before steam is raised, may be the best possible drains for the pipes; but where there is more than one boiler in a vessel it may often happen that, even if all the boilers are invariably used for steaming purposes, one only may be used in port for auxiliary purposes, and in this case leakage from its main stop valve will find the steam pipes leading to the other boilers receptacles for the condensed steam, which, if not drained, may be dangerous when opening the stop valves when raising steam in the other boilers. It is noteworthy that more than one of the serious accidents with pipes have occurred at the instant when stop valves were being opened.

Too much attention cannot be paid to the provision for draining steam pipes, and it is considered that it is preferable that these should be automatic, or such as not to require personal attention.

In the discussion which followed the reading of the above paper Mr. J. H. Morrison said that cast iron pipes were not now considered safe, so they had to deal with steel, wrought iron, and copper. As between these three he had in mind a case where an engineer had replaced copper steam pipes by iron, but incipient corrosion was observed. The iron pipes were taken down and copper ones put back. When a brazed pipe was made from the sheet the advantage was that it was possible to examine the copper sheet on both sides before it was formed into a pipe, but against this there was the disadvantage of brazing. Drawn pipes could only be examined on the outside. In solid drawn pipes a crack may be due to the die. It might not be very deep, but the pipe would break at that part. Another defect to which solid drawn pipe was subject was the want of uniformity, that is to say, a pipe would be thick at one side, while on another it would be thin. This was due to carelessness of manufacture. Reference had been made to the presence of arsenic, which, to a certain extent, increased the tensile strength, but it reduced the ductility. What was required for pipes was a copper with ductility and a fair amount of tensile strength also. A copper containing arsenic that might be good for fireboxes would not be suitable for tubes. He urged that tensile tests should be taken with the metal at a temperature equivalent to that of steam at the proposed working pressure. In a case he illustrated, with a given sample of copper, a tensile strength would thus be reduced from 14 tons per sq. in. to 11 tons. Oxygen played an important part in the working of copper. Some coppers appear to take oxygen, while some will not. In one instance copper feed pipe designed to stand 100 lbs. pressure per sq. in. would not stand a blow from a hammer without a piece being knocked out. As to annealing, he showed a sample which required a temperature of 2,000° F. before it became ductile, and it ought to be known that some brands of copper wanted greater heat than others to anneal then. Engineers thought that if copper were brought to a dull red heat it would be annealed, but this sample wanted a great deal more than that in treating it. The working coppersmith who was present when the experiment was made said that the gentleman was going to burn the copper, but it had to be heated to a white heat in order to anneal it. A most important point in working copper was the quality of the flame, for if there was a deficiency of oxygen, it would naturally make a material difference. The composition of the copper also entered into the question, and in a sample of pure copper which had been subjected to a very dense smoky flame for half an hour, although there were very small cracks developed, there was nothing approaching that observed in a sample of copper supplied by a manufacturer. The lapping of copper pipes by wire was claimed to make them absolutely safe, but this process should be applied to good pipes, and not used for making bad pipes passable. If one wire were used, and that were to break, or the pipe were to split circumferentially, so that the wire would fall into the crack, it then would become useless, but the pipe may be lapped in such a way that each turn of wire locks with its neighbor, and if one ring of wire broke, the connection would not be severed. The junction between the pipe and the flange he considered the weakest point, and a large number of accidents arose here. In order to overcome this difficulty, he had introduced a flange with projecting parts which would be brazed to the pipe, and thus give a larger area of connection, the lugs or projections being solid on to the flange. This had been found very successful. In one boat which had had the flange come away from the pipe on three successive voyages, they had adopted this method, and since then there had been no trouble. He thought the limit of elasticity in copper was much lower than most engineers supposed.

Mr. J. G. Stewart stated that his firm had made during the last 20 years many thousands of tons of lap-welded steel and iron steam pipes to work at pressures up to 500 lbs. per sq. in. The great advance in steam pressure which had taken place during that period had not been at all a source of trouble, as the thinnest steam pipe usualy made could be tested to a much higher pressure than any in use. The advance in size had caused a difficulty, as makers had hesitated to construct new plant to make the larger sizes, owing to the fact that the demand for large steam pipes was not sufficient to keep a plant at work. The extensive use lately of steel pipes for water mains had enabled his firm to put down new plant suitable for the largest sizes of steam pipes which it considered were ever likely to be required. It had recently supplied a number of steamers with wrought iron lap-welded steam pipes, and one firm of shipbuilders alone had taken pipes of this kind for 160,000 HP., none of which had given any trouble. Examination from time to time had shown no signs of corrosion going on, nor of external or internal scaling. These pipes had been fitted on all classes of steamers, including the largest afloat, and have been carrying the highest pressures used. For the assurance of the builders and owners, a great number of tests have been made of these pipes, sometimes to destruction. Strips were broken across the weld, and the result of these tests was that the lowest result obtained by hydraulic bursting of the pipe or by breaking at the testing machine showed an ultimate strength of 16 tons per sq. in. The pressures at which the pipes burst were in every case many times the working pressure, in some cases as much as ten times. Although wrought iron had been almost invariably the material used, the best material for steam pipes the speaker believed to be mild open-hearth steel. The advantages possessed by steel over iron are greater uniformity of quality and more reliability. As the result of a great number of tests of lap-welded steel joints in pipes and lap-welded iron joints, he had come to the conclusion that the steel pipe is more reliable. This he knew to be contrary to the general opinion, but it was the result of hundreds of tests of steel welds. The method of welding a tube and rolling it at a high heat is more akin to cogging a steel ingot than to the process of welding by a smith with hammers. To test this question, he recently experimented by breaking strips cut from across the weld of both iron and steel pipes. The ultimate breaking strength of the iron weld was from 17 tons as a maximum to 15½ tons as a minimum, and of the steel it was from 24.5 tons maximum to 23 tons minimum. The tests in each case were eight strips cut from four tubes. Judging from past experience, this was exactly what he had expected, and would give the iron weld as only possessing 67% of the strength of the steel weld. The reasons why the Board of Trade enforce the use of the weaker and less trustworthy pipe, and why the Admiralty order a butt-strap to be riveted over a steel weld, can only be that they require experience and proofs of such facts. He would have no hesitation in guaranteeing the strength of a steel weld, but would be very chary of guaranteeing iron pipes to stand much more than half the pressure that a steel pipe of equal thickness would withstand. The butt-strap over the weld is more than useless, as the pipe is weakened by the riveting, and every rivet may be a source of leakage. His firm had in its works steel steam pipes from 23 ins. diameter by 5-16 in. thick, down to 6 ins. by 3-16 in., working at 100 lbs. pressure. It was hardly correct to say that manufacturing conditions require steam pipes to be so thick as to allow of no advantage from the use of the stronger metal. Taking the test pressure of iron at 7 tons per sq. in. and steel at 11 tons, proportionate to the breaking strengths, it would be found that for pipes about 24 ins. diameter to stand 600 lbs. per sq. in., the iron tube would have to be fully ½ in. thick, while the steel tube could withstand this test if 0.31 in. thick, that is, 5-16 in., not much more than half the weight. The weld will stand extending hot from 24 ins. to 28½ ins. at one operation, or 20% elongation. It is a matter of common experience that wrought iron boiler tubes do not corrode so rapidly as steel tubes, but there does not seem to be any appreciable corrosion in steam pipes, probably owing to the purity of the condensed water which may be in them. If any doubt of the steel weld is entertained, care may be taken to test it very thoroughly. Its ultimate strength should be 20 tons per sq. in. of section, and the pipes may be subjected to a hydraulic pressure giving a good stress on the weld. Up to 8 or 9 tons no injury can be done to the pipe. While the pressure is held the weld may be rapped with hammers from one end to the other. As to joints for iron or steel steam pipes, he considered the riveted joint the least satisfactory, as the steam cuts or wears the rivet heads, and all the rivets are liable to leak. It is not in much use for high pressure. A cast steel or forged flange, properly screwed on and riveted over into a slight recess on the face, forms a better joint. Several tests which his firm had made of this description of joint, to satisfy users, had given good results, the pipes being burst by hydraulic pressure without moving the flanges. The welded-on flange, properly constructed, had withstood very high test pressures. A pipe 9¼ ins. diameter with welded flanges was subjected to a pressure of 2,400 lbs. per sq. in., at which pressure the pipe burst. The pressure on the flange was thus 73 tons, but there was no sign of failure perceptible in the welding of the flange. Flanges can also be made solid with the tube, and ought to be satisfactory, being free from all objection to which any of the other flanges might be subject, excepting the increase of cost. Bends up to 22 ins. diameter have been made, but owing to molding blocks being required for every size of bend, single bends were costly. Branches of almost all descriptions had been welded on to the pipes, and he had no doubt that the supply for these connections would not be behind that of the pipes if a sufficiently great demand arose to employ the special tools required for each size and shape.

Mr. James Riley said that 19 years ago he introduced in that room a material (steel) which had obtained the reputation of being "treacherous." Now, it seemed, the scene was changed, his treacherous material had been found to be trustworthy, and copper treacherous. As to the troubles with copper he wondered whether mild steel would have caused as much difficulty. He had seen a considerable number of steam and large water-pipes made of mild steel, and in no case had any accident or difficulty arisen through their use. Lloyd's Society and the Admiralty took particularly stringent steps in regard to the testing of steel, and that doubtless was largely the reason why now the steelmakers could supply this trustworthy material. He had often thought that if makers of other metals were treated in the same drastic manner, they might be brought to the pitch of excellence arrived at by the steelmakers. In regard to corrosion, he did not know of a case of corrosion in steel pipes made of steel.

Mr. A. E. Seaton said that five or six years ago he suggested that engineers should take advantage, in the manufacture of steam pipes, of the mild steel of which Mr. Riley had just spoken, and he also suggested that they should cast aside copper pipes; not that the metal had been faithless in the past, but that they had a better friend in mild steel. In the early days of the water-tube boiler, copper had been used as the material for the pipes, as the manufacture of iron pipes was not then reliable, and often butt-welded pipes had to be used. Mr. Milton had expressed some surprise at finding steamers fitted with cast iron steam pipes, but he could assure him that 20 years ago cast iron pipes were very largely fitted, and these were put in because of the corrosive action of copper pipes upon iron. Eleven years ago a steamer was built for the Great Eastern Ry. which had cast iron pipes. This had recently come into the hands of his company at Hull, and the pipes being found in good condition, were replaced after being taken down. When cast iron pipes were fitted the Board of Trade required them to be drilled and plugged, in order that they might be examined. He had fitted ships with wrought iron pipes, and would have used mild steel, but the Board of Trade objected to the latter metal, so he had to content himself with wrought iron. In attaching the flange he wished to use electrical welding, and had tried it in one case. The welding, however, was not complete over the whole surface, and the Board of Trade would not,

therefore, pass it, although by way of test they had pulled the pipe to pieces before they could get the flange off. He had fitted iron pipes with flanges brazed on, when time had been pressing, and his experience was that there was no surface corrosion nor erosion due to this method of treatment. He had experienced pitting in iron steel pipes, but this was only in one short length which was taken from the immediate neighborhood of the boiler, and though there were cavities of considerable size, the surface of the metal was as black as when it was put in. This was in iron, not in steel. He did not attach much importance to the fact. Another case which he called to mind was a joint made with an iron pipe to a gun-metal stop valve, and part of the pipe had gone away; whether this was due to the asbestos used in making the joint he could not say, but he had formerly observed the same thing when using asbetos with iron pipes. In regard to flanging the pipe on the solid, he had endeavored for long to get this done, and at last the matter was taken up by Mr. Howell, of Sheffield, who, by a process of upsetting, was able to get the flange solid on the pipe. But this was with steel, and here again the Board of Trade stepped in, and, as it insisted upon iron pipes, the full benefit of the process was not obtained. He thought it possible that in the future we might have bronze steam pipes, but he did not hope much from that.

Mr. J. I. Thornycroft said Mr. Milton's paper proved that though copper has difficulties associated with its use for steam pipes, yet as more light is gained difficulties disappear. He was very glad to hear from Mr. Riley that steelmakers could now give a metal trustworthy in small castings. He had ordered some check valves for boilers of steel, but when these were put under the hammer to test them, in place of doubling up as copper would have done, they broke like glass bottles. This was a disappointment. In regard to steel pipes, if they could get the flanges on solid, it would be a great step in advance. In the engines of the vessels built by his firm, lapped copper pipes were used, having three wires, so that if one burst, two, at least, would be left. A lapped pipe might be said to consist of a pipe with a large number of transverse cracks extending partly through the metal. As to cast iron pipes, he would point out that stop valves and cylinders of cast iron were used with great success. A cylinder was a large and complicated casting, and if an iron casting could be used in this position, why not in a steam pipe? In regard to drilling and inspection holes, he pointed out that the hole would be a source of weakness, and the pipe might then be easily broken.

Mr. Laird said his firm had used solid drawn tubes of mild steel, with entire immunity from accident.

Mr. A. Langton expressed his opinion that steel was the right material for large steam pipes, supposing the welding were efficiently performed. Care should, however, be taken to see that in the neighborhood of the weld the steel pipes were free from minute cracks. A proposal had been made to him to put butt-straps over the weld, but this would be introducing a source of weakness, as the rivet holes would reduce the strength. He had had to reject steel pipes, and in all cases the makers had attributed the defect to the steel not being mild enough. Another objection to the riveted butt-strap was that the steam would erode the inside of the rivet. In regard to the lapped copper pipes, he gave an instance of a 12-in. pipe with metal ⅛ in. thick; in this case, when lapped with ⅛-in. wire, the tensile strength was doubled; with 3-16-in. wire three times the strength was obtained. Mr. Langton was of opinion, however, that with the higher pressures now used, steel was the right material for steam pipes.

Mr. Milton, in replying to the discussion, said that he was glad Mr. Stewart had recommended the very severe test of hammering the pipe when under pressure, for steel pipes. The test for pipes had been reduced against the wish of the pipemakers. As to what Mr. Langton had said about cracks in the neighborhood of the weld, he would like to know whether the pipe had been made by rolling on the mandril or by hammering? He thought, probably, that not only would it be found that the steel had been hammered, but it was hardened by the process.

FAILURE OF THE DAM OF THE BOUZEY RESERVOIR IN FRANCE.

The disastrous failure of the dam of the Bouzey reservoir, near Epinal, France, on April 27, resulting in the loss of nearly 150 lives, was recorded in our issue of May 2. We are indebted to Mr. W. Bell Dawson, Assoc. M. Inst. C. E., of Ottawa, Canada, for further particulars of the reservoir and dam. The dam was built across the small stream of the Aviere to form a storage reservoir for supplying the summit level of the Eastern Canal, which here crosses the Vosges mountains in connecting the rivers Moselle and Saone, this canal being a link in the water communication between the North Sea and the Mediterranean. The reservoir had a capacity of 1,470,000,000 gallons, and was fed by an aqueduct which taps the Moselle higher up the stream. The following description of the reservoir and dam is taken from a paper on "The Eastern Canal of France,"* written by Mr. Dawson in 1878, while the works were in progress:

The Bouzey reservoir, into which the aqueduct discharges, is in the valley of the Aviere. It is no longer necessary to prevent the water flowing in this stream from leaving the reservoir, as was intended in the original scheme, for the supply is now independent of the rainfall in its basin. It was desirable to place the retaining dam as near as possible to the canal, in order to increase its area; but as an old quarry exists near the canal, it was thought prudent to put the dam at least 50 yds. above it. The valley in question is formed of a streaked reddish sandstone (Gres bigarre), much jointed; but as ponds were found in the valley, it was inferred that the leakage would not be so great as to make the establishment of a reservoir impossible. It was ascertained by borings that the sandstone maintains its fissured and jointed character for a considerable depth, below which the beds become solid and continuous. The height of the dam required is 58 ft. at the center of the valley. As it would be difficult to construct a substantial earth dam of such dimensions, and little earth was to be had in the vicinity, it has been decided to build it of masonry. The wall will not be completed to its full height at first, as the capacity of the reservoir is sufficient for the probable traffic of the canal for some years to come; but the dimensions will enable it to be raised to its final height by simply adding the part left unbuilt. According to the designs prepared for this retaining wall the width of the top is 13 ft. This width, though less than usual, is considered sufficient to resist the action of any waves likely to rise on a surface which has only an extent of 247 acres. Its height above the level of the water is nearly 2 ft., and there is in addition a parapet 3 ft. 3 ins. high on the side next the water. The inner face is vertical. The curve of the outer face is so calculated that the pressure may nowhere exceed 156 lbs. on the square inch. The sandstone used for the masonry has a specific gravity of from 2.0 to 2.2. When soaked with water, this is increased from 6 to 8%, and, by taking these higher values of the specific gravity, the maximum pressure is found to be less as the curve of pressure approaches the vertical. The stone crushes under a pressure varying from 2 to 4 tons per square inch, and will be built with hydraulic lime from Theil.

The foundation of the wall presents much difficulty. On the right side of the valley the ground is the more favorable, as there the rock is solid and impermeable at a depth of from 10 ft. to 20 ft. below the surface. At the center of the valley there is a bed of peat 28 ft. thick, but below it the rock seems very compact. On the left side of the valley the upper beds are completely broken up into loose blocks, separated by wide cracks, and the foundations will there have to be taken down to a considerable depth. It is not necessary, however, that the whole thickness of the wall should rest upon the impermeable beds, as the main body of the masonry can have as a foundation any of the beds above, whether they be fissured or not. A guard wall, 6½ ft. thick, will be carried down vertically below the inner face of the wall till it reaches the impermeable beds. At the right side of the valley the masonry will end abruptly against the rock, which is here highly inclined, and there will be no difficulty in making the connection; but at the other side it will be necessary to prolong the wall by tunneling into the hillside to a distance of 180 ft., in order to prevent the water from passing round its end. At this point the surface of the impermeable beds is only 6 ft. below the level of the water in the reservoir, and, as the rock is covered with a thick layer of compact soil, it is not thought likely that there will be any leakage worth considering. The reservoir is to be provided with a waste weir, and the usual tower containing the outlet and emptying valves.

It is stated that in 1884 the water attained its highest level in the reservoir, being about 40 ft. at the dam, the pressure causing a horizontal movement or bulging of the dam, with cracks in the masonry which allowed considerable leakage. The main body of the dam thus became partially detached from the guard wall above mentioned. Heavy concrete backing was built against the downstream face, parts of the dislocated foundation were rebuilt, and the cracks were cleaned out and filled with cement. The dam as thus strengthened is said to have been amply strong to resist the pressure of water at the full depth of the reservoir. Another correspondent states, as noted last week, that the dam was cracked last winter by the contraction and expansion due to the extreme changes in temperature, and that the pressure of water bulged the face about 3 ft. at that time.

* Minutes of Proceedings of the Institution of Civil Engineers, Vol. IV., 1878-79, part 1.

BOOK REVIEW.

THE SLUMS OF BALTIMORE, CHICAGO, NEW YORK AND PHILADELPHIA. Seventh Annual Report of the Commissioner of Labor. Prepared in compliance with a joint resolution of the Congress of the United States, approved July 20, 1892, by Carroll D. Wright, Commissioner of Labor. Washington, D. C.: Government Printing Office. 8vo; 620 pp.

The resolution of Congress referred to applies to all cities of 200,000 inhabitants and over, and the present volume is the first installment of the report called for. According to the report the total slum population of Baltimore is 25,000; of Chicago, 162,000; of New York, 360,000, and of Philadelphia, 35,000; but the districts actually canvassed, selected from the worst in these four cities, include an aggregate population of only 83,852. In the 16 cities of the United States falling under the resolution of Congress, the estimated total slum population is 800,000. The districts considered include the dirty, back streets of cities, especially those inhabited by a squalid and criminal population, or low and dangerous neighborhoods. The general results of the investigation are set down as follows for the four representative cities selected. In New York city, as a whole, there was one liquor saloon to every 200 persons, but in the slums one to every 129 inhabitants. In Philadelphia there was one liquor saloon to every 870 persons, and one to every 502 in its slums. In Baltimore there was one saloon to every 229 persons, and one to every 105 in the slums. In Chicago, in the city at large, there was one saloon to every 212 persons, and one to every 127 in the slums. The record of arrests for the police districts in the slums of the various cities are instructive, though necessarily incomplete. The male sex predominates in all the slums; the males of the New York slums, for example, representing 54.61% of the total population, as compared with 49.34% for the entire city. Some of the other figures given may be set down in tabular form as follows:

	New York, P. c.	Baltimore, P. c.	Philadelphia, P. c.	Chicago, P. c.
Foreign born in city....	42.23	15.88	25.74	40.98
" " " slums...	62.58	40.21	60.45	57.51
Illiteracy, in city.....	7.69	9.79	4.97	4.63
" " slums.....	46.65	19.60	37.07	25.37
Foreign-born voters, city..	49.93	20.13	29.52	50.62
" " slums.	62.44	44.04	58.94	61.31
Persons each dwelling, city	18.52	6.02	5.60	8.60
" " " slums	36.79	7.71	7.34	15.51

One remarkable fact developed in the house-to-house canvas of the slums was that no greater sickness prevailed in these districts than in other parts of the cities where the investigations were made; and while the most wretched conditions were found, the small number of sick people met with was a surprise to the canvassers. Special sanitary examinations were made in 311 tenements in New York and 131 in Philadelphia by Dr. Alfred S. Houghton. These were made in April, 1893, and February and March, 1894. Dr. Houghton said the almost complete absence of pathogenic germs in the air of the slums was astonishing. He found that in winter, with the windows and doors closed, while the percentage of carbon dioxide in many instances was greater, the smoke from open fires and the low temperature operated to reduce the bacteria in the air almost to nothing. The absence of carpets, upholstered furniture and curtains, which hold bacteria in the houses of the better class, also help to account for the absence of germs. Without any exception, says Dr. Houghton, the air in the tenement houses was as pure as in any residence visited. The worst place found was the People's Theater, in the Bowery, where the percentage of carbon dioxide was 0.002, the temperature 80° and the humidity 65%. In 107 tenements examined, in only 15 did the percentage of carbon dioxide reach 0.001, and in only 7 instances was it 0.002.

An experimental test of re-forged armor-plate was made at Indian Head, on April 27. A Carnegie 8-in. plate had been forged down to 6 ins. in thickness, and this was twice fired at by a 6-in. gun, the projectile having a velocity of 2,100 ft. per sec. The first shot barely penetrated the plate and was badly broken, and the second did not get through the plate. Another test was made of a 13-in. semi-armor-piercing projectile, carrying 44 lbs. of high explosive. With a velocity of 900 ft. per sec. the projectile went completely through a 7-in. plate rolled down from a much thicker plate.

CONTENTS OF SUPPLEMENT.

PERSONALS.....145
ENGINEERING SOCIETIES.....145
Coming Technical Meetings.....145
NEW PUBLICATIONS.....145
Trade Publications.....146
CONSTRUCTION NEWS:
List of Contracts Pending.....146
Railways.....146
Street and Electric Railways.....147
Electric Light and Power.....147
Bridges.....147
Buildings.....148
Water-Works.....148
Irrigation.....149
Sewerage.....150
Garbage Disposal.....150
Streets and Roads.....150
Miscellaneous Contracts and Supplies.....150
Contract Prices.....150
Metal Market Prices.....152
INDUSTRIAL NOTES.....152

PERSONALS.

Mr. Amos A. Gould has been elected Water Commissioner at Leicester, Mass.

Mr. Emil L. Neubling has been elected City Engineer and Superintendent of Water-Works at Reading, Pa.

Mr. R. G. Scott has been appointed Roadmaster of the Laredo & Taylor Division of the International & Great Northern R. R.

Mr. Thomas L. Wilkinson is now engaged in general practice as a mechanical engineer, with offices at 610 Boston Building, Denver, Colo.

Mr. Lewis Kingman, M. Am. Soc. C. E., has been appointed Chief Engineer of the Mexican Central Ry., with headquarters at the city of Mexico.

Mr. George F. Gardner has been appointed Superintendent of the Pittsburg and Clearfield & Mahoning divisions of the Buffalo, Rochester & Pittsburg R. R., with headquarters at Bradford, Pa.

Mr. Charles Kesling, formerly Division Engineer on the Lehigh Valley R. R., sailed May 4 for Europe to accept a position in the Austrian State Railway Department, with headquarters at Vienna.

Mr. J. W. Fryer has been engaged by the Smith & Winchester Co. to take charge of its New York office at 141 Center St., for the sale of heating boilers and general gas and water-works supplies.

Mr. Campbell Wallace, formerly President of the East Tennessee, Virginia & Georgia R. R., and a member of the Railroad Commission of Georgia from its organization in 1879 until 1890, died at Atlanta, Ga., May 3.

Gen. Geo. P. Delaplaine, who died at Madison, Wis., April 30, was born in Philadelphia, Pa., in 1814. He was engaged in the survey of government lands in Wisconsin and was Engineer-in-Chief of the state militia under Governor Randall, with the rank of brigadier-general.

Mr. E. L. Corthell, M. Am. Soc. C. E., has returned from Europe, and his many friends will be glad to learn that his health is practically restored. The New Orleans "Picayune" says that he is soon to resume active work in connection with the proposed bridge across the lower Mississippi River at New Orleans.

Mr. Thomas Rutter, engineer and contractor, died in New York city, May 3. He was born in Wales in 1824 and came to this country while a boy. He was engineer and contractor on several large railway works, and was one of the contractors for the Alleghany tunnel, the Washington Aqueduct and the Baltimore Belt tunnel.

Mr. E. D. Wright, Superintendent of the Southwestern Division of the Chicago, Milwaukee & St. Paul R. R., has been transferred to the Kansas City Division, and Mr. J. C. Cable, Superintendent of the Milwaukee and Council Bluffs divisions, has had his jurisdiction extended to include the Southwestern Division.

Brig.-Gen. Thomas L. Casey, Chief of Engineers, U. S. A., will be on the retired list after this week, as he attains the age of 64 on May 10. He was born at Sacketts Harbor, N. Y., in 1831, graduated at West Point in 1852, and after some experience on river improvement was assistant professor of engineering at West Point. He served in the engineer corps during the war, and in 1867 was ordered to Washington as assistant to the Chief of Engineers for duty in connection with fortifications. He remained on this duty until 1877, when he was detailed for duty as engineer in charge of public buildings and grounds in Washington, the Washington aqueduct, the construction of the State, War and Navy Departments building and the Washington monument. In 1879, while in charge of the Washington aqueduct, he made a report recommending as the best method of increasing the water supply for the benefit of the residents of Capitol Hill that an additional 48-in. main be laid from the distributing reservoir to the hill. This plan was rejected in favor of a plan submitted by the engineer officers of the District, which plan contemplated the construction of a tunnel conduit and a reservoir north of the city. Owing to faulty work, however, after more than a million dollars had been expended, the tunnel had to be abandoned, and in 1889 Congress adopted the plan of Gen. Casey, and appropriated $524,000 for its execution. Gen. Casey has also been identified with the improvement of the Potomac River. In June, 1878, he made a report to the Chief of Engineers for the information of Congress in favor of erecting a dike along the western edge of the Potomac flats, to improve the sanitary condition of the city. He was made lieutenant-colonel of engineers in 1874; colonel in 1884, and brigadier-general and chief of engineers, July 6, 1888. Since that time he has been stationed in Washington, at the head of his bureau. He is a member of the American Society of Civil Engineers, and an officer of the Legion of Honor of France. Although he will relinquish his present office in a few days, Gen. Casey will be enabled to continue his services for the District of Columbia for some time, as he has been specially designated by Congress to complete the Congressional Library Building and to act as consulting officer in the completion of existing projects for increasing the water supply of this city, which duty includes the determination of the question of the utility of the abandoned tunnel. Among Gen. Casey's most interesting engineering work was the strengthening of the foundation of the Washington monument, in Washington, D. C., by which it was made possible to build the shaft to its full intended height of 500 ft.

ENGINEERING SOCIETIES.

COMING TECHNICAL MEETINGS.

MONTANA SOCIETY OF CIVIL ENGINEERS.
May 11. Secy., Forrest J. Smith, Denver Block, Helena, Mont.
INDIANAPOLIS ENGINEERING CLUB.
May 11. Secy., C. C. Brown, City Engineer.
ENGINEERS' CLUB OF KANSAS CITY.
May 13. Secy., F. W. Tuttle, Baird Building.
NORTHWESTERN SOCIETY OF ENGINEERS.
May 14. Secy., D. W. McMorris, Burke Building, Seattle, Wash.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
May 14. Secy., F. A. Coburn, Case Library Building.
NORTHWEST RAILWAY CLUB.
May 14. Secy., C. A. Seley, Metropolitan Block, St. Paul, Minn.
WISCONSIN POLYTECHNIC SOCIETY.
May 14. Secy., W. K. Means, Loan & Trust Building, Milwaukee.
DENVER SOCIETY OF CIVIL ENGINEERS.
May 14. Secy., H. Breen, 36 Jacobson Block.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
May 15. Secy., J. H. Pilcher, Roanoke, Va.
ENGINEERS AND ARCHITECTS' ASSOCIATION OF SOUTHERN CALIFORNIA.
May 15. Secy., F. Van Vleck, Los Angeles, Cal.
WESTERN SOCIETY OF ENGINEERS.
May 15. Secy., Chas. J. Rouey, 1736 Monadnock Block, Chicago.
BOSTON SOCIETY OF CIVIL ENGINEERS.
May 15. Secy. S. E. Tinkham, City Hall, Rooms 36 Bromfield St.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
May 15. "Water-Works of Syracuse, N.Y.," by W. R. Hill. Annual meeting at Nantasket, Mass., June 18. Secy., C. W. Hunt, 127 E. 23d St., N. Y. city.
ENGINEERS' CLUB OF ST. LOUIS.
May 15. "An Experimental Investigation of the Three-Moment Theorem," by M. A. Howe. Secy., W. H. Bryan, Turner Block.
NEW YORK RAILROAD CLUB.
May 16. Secy., John A. Hill, 256 Broadway, N. Y. city.
ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.
May 16. Secy., D. Carhart, Carnegie Library Building, Allegheny.
ENGINEERS' CLUB OF CINCINNATI.
May 16. Secy., J. F. Wilson, Odd Fellows' Temple.
ENGINEERS' CLUB OF PHILADELPHIA.
May 18. Secy., L. F. Rondinella, 1122 Girard St.
ENGINEERS' CLUB OF MINNEAPOLIS.
May 20. Secy., E. Nexson, Kasota Block.
WESTERN RAILWAY CLUB.
May 21. Secy., W. D. Crosman, Club Room 9, Grand Pacific Hotel, Chicago.
COLUMBIAN ENGINEERING SOCIETY.
May 21. Secy., W. F. Hart, University Building, 15th and H Sts. N. W., Washington, D. C.
ENGINEERING ASSOCIATION OF THE SOUTH.
May 23. Secy., H. D. Ruhm, Nashville, Tenn.
AMERICAN WATER-WORKS ASSOCIATION.
May 28 to 31. Annual meeting at Atlanta, Ga. Secy., Peter Milne, New York, N. Y.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
May 23. Secy., C. L. McLeod, 12 Mansfield St., Montreal.
ENGINEERING CLUB OF COLUMBUS, O.
June 1. Secy., David Buell.
ENGINEERING SOCIETY OF WESTERN NEW YORK.
June 3. Secy., Geo. R. Sikes, 122 Pearl St., Buffalo, N. Y.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
June 7. Secy., O. H. Von Geldern, 819 Market St., San Francisco.
MASTER CAR BUILDERS' ASSOCIATION
June 11. Annual Convention at Alexandria Bay, N. Y. Secy., J. W. Cloud, Rookery Building, Chicago, Ill.
ASSOCIATION OF RAILWAY TELEGRAPH SUPTS.
June 12. Montreal, Que. Secy., P. W. Drew, Wisconsin Central Ry., Milwaukee, Wis.
ENGINEERS AND ARCHITECTS' CLUB OF LOUISVILLE.
June 13. Secy., Jas. K. Zollinger, Norton Building.
NORTHWESTERN TRACK AND BRIDGE ASSOCIATION.
June 14. Secy., D. W. Meeker, St. Paul, Minn.
AMERICAN RAILWAY MASTER MECHANICS' ASSOC'N.
June 17. Annual Convention at Alexandria Bay, N. Y. Secy., Angus Sinclair, 256 Broadway, New York city.

ASSOCIATION OF ENGINEERS OF VIRGINIA.—The regular informal monthly meeting was held at Roanoke, Va., April 17. Prof. L. S. Randolph, of Blacksburg, Va., read a paper on "Engineering Education," in which he brought out the distinctive features in the methods of teaching in England, in Germany and in America. The weak and the strong points of the different systems were brought out and discussed and the very important question of just how far the student in one branch of the profession should be carried into the others was raised. Also the question of how much time should be given to the practical and how much to the theoretical part of the training.

John A. Pilcher, Secy.

ENGINEERING ASSOCIATION OF THE SOUTH.—At the regular informal meeting, held at Nashville, Tenn., April 25, the discussion was on "City Street Paving," opened by Mr. Leftwich, who referred especially to granite paving in Nashville. A general discussion followed, the main features of which were the condemnation of macadam for city paving, and the recommendation of standard specifications for use over the entire country. Herman D. Ruhm, Secy.

ENGINEERS' CLUB OF ST. LOUIS.—At the meeting on May 1 Mr. William H. Bryan addressed the club on "Boiler Trials." He gave the following figures as the result of a large number of investigations made on boilers and furnaces in and near St. Louis, burning soft coals:

Average efficiency of the common boiler and furnace, 51.35%; range, 44.8 to 60.4%; water tube boilers with common furnace, 60 to 70%; best form of improved furnace, under ordinary boilers, 58 to 60%, under water tube boilers, 70 to 75%. In capacity the maximum evaporation in pounds of water per sq. ft. of heating surface per hour from and at 212°, and the capacity on the basis of percentage of work done above the normal capacities of the boilers were as follows:

	lbs.	%
Boilers with 2½-in. tubes	4.17	81
" " 6-in. "	7.81	113
" " large flues	8.80	92
" " water tubes	7.26	70

William H. Bryan, Secy.

WESTERN RAILWAY CLUB.—The meeting of the club held April 16 was devoted entirely to the discussion of special topics, no paper being read. The first subject to come up for discussion was the paper of Mr. C. A. Goodnow on the train staff system (Eng. News, April, 1895). The applicability of the system to long stretches of single track line was questioned, and Mr. Goodnow answered that it was simply a question of cost. He considered that there was no doubt about the system being perfectly applicable from a mechanical or operative point of view, but said that the cost of installation was high, about $200 for each staff machine, or $400 per station. The next discussion was on the strength of car axles, and was opened by Mr. D. L. Barnes, who stated that, when the excess loads due to the oscillation of the car and bottoming of the springs was considered, calculation indicated that with the present M. C. B. sizes for axles the metal was being overstrained. He also stated that the theory of the stresses in axles indicated that they should be straight between wheels instead of tapered toward the center. Mr. J. N. Barr, Mr. Wm. Forsyth and Mr. G. W. Rhodes answered at some length, the gist of their replies being that whatever theory might prove as to the danger of the present sizes of axles breaking between wheels, the fact was that they seldom did so break, and, moreover, the present tapered axle had been evolved by experience from the straight axle as being more safe. This was followed by a long discussion on interchange rules, and a large number of changes were recommended, all of which will be given in the printed proceedings of the club for April.

NEW PUBLICATIONS.

REPORT OF THE BOARD OF RAILROAD COMMISSIONERS OF MASSACHUSETTS. Twenty-sixth Annual Report, 1894. Published by the Commission, Boston, Mass. 8vo; pp. 359.

This report is in the usual complete and comprehensive form, reviewing the financial and technical matters connected with the operation of the railways in the state during the year. It also takes up the questions of electric railways, car fenders, grade crossings, etc. Several pages are devoted to tabular statements; and there is an excellent map.

MICHIGAN STATE BOARD OF HEALTH.—Report of the Secretary for the Year Ending June 30, 1892. Henry B. Baker, Secretary, Lansing. 8vo; cloth; pp. cxlvi., 416; many diagrams and tables.

The Michigan studies of sickness and death rank high among those of the world, and are very fully presented in this volume. The meteorological conditions in Michigan for 1891 are given in detail, illustrated by diagrams, and advice to municipalities on

sanitary engineering questions during the year is also included.

It will be observed that this report is very much behind hand. This is said to be due to an insufficient working staff and the fact that current work of vital importance is given first attention. However, an abstract of the proceedings of the meeting of the Board on Jan. 11, 1895, is already at hand, and such bulletins are published at frequent intervals, giving such information as needs to be fresh to be of value.

PROCEEDINGS OF THE AMERICAN FORESTRY ASSOCIATION.—Vol. X., Part 3. F. H. Newell, Secy., Washington, D. C. 8vo; pp. 47; 25 cts.

This part contains the following papers: "Conditions of Forestry in California," by Abbot Kinney; "Forest Conditions in the Gulf States," by Dr. Charles Mohr; "Forestry in New South Wales,' by Robert Hudson; "Forest Conditions and Forestry Problems of Venezuela," by D. A. Ernst; "The Great Coast Forest of the Pacific Slope," by E. W. Hammond; "Forest Reserves of the Western Mountain Region," by E. T. Ensign; "Forest Administration," by George H. Parsons; "Timber and Wood Consumption in the Comstock Mines," by William Alvord (we shall publish an abstract of this paper shortly), and "The Effective Method of Advancing Forestry Interests," by Herbert Welsh.

AMERICAN WATER-WORKS ASSOCIATION.—Proceedings of the Fourteenth Annual Meeting, Held at Minneapolis, Minn., 1894. New York: Published by the Secretary, Peter Milne, 95 William St. 8vo; paper; pp. 207; one illustration and tables; $1.

Many of the papers presented at last year's meeting of the Association were discussed by a number of members, and as the range of subjects before the convention was large the report is an interesting one. The papers and their authors are as follows:

"Niagara Water Power," by Emile Geyelin; "The Water Supply and Fire Protection of the World's Columbian Exposition," by Wm. S. McHarg; "Filtration," by Jos. B. Rider; "Damages for Appropriation of Streams," by P. D. Wanner; "Wells and Subterranean Water Supply," by W. de H. Washington; "Criticism on Some Methods of Reporting Water Analyses, with Suggestions for Uniform System," by Henry Leffman; "Methods and Cost of Street Sprinkling," by F. A. W. Davis; "Filtration and Purification of the Mississippi River and New Plan of Distribution for Minneapolis," by F. W. Cappelen; "Experience with Fire Protection Lines," by F. A. W. Davis; "Socialism and Politics in Water-Works Practice," by L. H. Gardner; "Geology, Its Influence on Water Supply," by D. W. Meade; "Evolution in Water-Works Construction and Maintenance," by Peter Milne; "Cast Iron, Wrought Iron and Steel Pipes," by I. M. De Varona; "Prevention of Electrolysis," by O. N. T. Smith; "Electrolysis, Experience and Opinions," by A. A. Tucker; "Electrolysis versus Water-Works Systems," by C. Monjeau; "Report of the Special Committee on Electrolysis."

TRADE PUBLICATIONS.

MACHINE TOOLS.—Morton Mfg. Co., Muskegon Heights, Mich. Oblong; 8½ × 6 ins.; pp. 40.

This is a well-printed catalogue containing detailed descriptions, with cuts, of different styles of key-way cutters. A shaft milling machine, draw-cut shaper and portable combined planer and key-way cutter are also shown.

BLOCK SIGNALS.—Mozier Safety Signal Co., Cleveland, O., and Galion, O. Paper; 8vo; pp. 16; illustrated.

This pamphlet is descriptive of the Mozier system of three-position semaphore signal for block working on single track. It is in use on the New York, Lake Erie & Western R. R., and has been described in our columns.

COAL MINING MACHINERY AND PLANT.—Jeffrey Mfg. Co., Columbus, O. Oblong, paper, 11 × 8; pp. 48; illustrated.

This catalogue contains illustrated descriptions of different styles of coal-cutting machines and drills, operated by air and electricity. Electric locomotives, pumps and hoists are also shown, together with the Jeffrey system of conveying and elevating plants for handling coal at yards, coaling stations and tipples.

PRESSES AND DIES.—Ferracute Machine Co., Bridgeton, N. J. Paper, 7 × 10 ins.; pp. 32.

This catalogue shows a number of new designs of foot and power presses, lathes, beaders, dies, etc., for working various kinds of bar and sheet metals. Descriptions are given of the machines, together with tables of dimensions, prices, etc. Some of the presses are fitted with electric motors and controllers, and those on which a number of consecutive operations are performed (such as for stamping buttons, etc.) are fitted with dial feed.

HOISTING AND CONVEYING PLANT.—Brown Hoisting & Conveying Machine Co., Cleveland, O. Oblong, 6¾ × 10¼ ins.; pp. 45; illustrated.

This publication consists of a large number of excellent half-tone engravings, showing the various applications of the company's plant for coal yards, docks, shipbuilding yards, excavation, etc., with descriptions of the plants, and particulars of capacity, etc. Among the prominent features are the cantilever cranes on the Chicago drainage canal; the movable bridge tramway for unloading and conveying coal and ore; sewer trench machine, traveling cranes, overhead cable tramways, and a furnace hoist for charging blast furnaces. Details are given of the capacity, cost of operation, etc. The book is handsomely printed on fine paper.

INDUSTRIAL RAILWAYS. C. W. Hunt Co., New York. 8vo; pp. 40; illustrated.

One of the important features in the equipment of manufacturing establishments is the provision of ample facilities for the prompt and economical handling of coal, ashes, supplies, etc., and for the handling of the raw material and the finished product, both in the yards and in the shops. It is for this particular purpose that the Hunt system of narrow gage industrial railways has been designed, as well as for handling coal, ashes, etc., in office buildings, power stations, etc. The system has been extensively adopted and was described and illustrated in our issue of June 16, 1892. The catalogue shows the track, switches, turntables, etc., as made in sections ready for use, and also various forms of dump and flat cars for earth, phosphate, coal, etc. Among the specialties in this line are water-cooled cars for handling hot coke, foundry ladle cars (Eng. News, Oct. 19, 1893), barrel cars, and "saddle-bag" cars for the Lartigue single-rail railway at the Tampico Harbor works. There are also steam and electric locomotives, one of the latter having been built for the Brockway mines. Plans are given of the track systems of the Ridgewood pumping station at Brooklyn, N. Y.; the Otis Co.'s mills at Ware, Mass.; the State House at Boston, Mass., the Postal Telegraph Building in New York, etc.

CONSTRUCTION NEWS.

CONDENSED LIST OF CONTRACTS PENDING WITH DATE OF OPENING BIDS.

Bids to be opened.	Work.	Place.	See Eng. News.
May 10.	Bridge, Plymouth, Ind.		Apr. 11
May 10.	Paving, St. Louis, Mo.		Apr. 25
May 10.	Drill hall, Newport, Ky.		Apr. 25
May 10.	Cast iron pipe, West Point, N. Y.		May 2
May 10.	Brick paving, Cincinnati, O.		May 2
May 10.	Wharf at Gardner's Creek, N. B.		May 2
May 10.	Pipe sewers, Pittsburg, Pa.		May 2
May 10.	Artesian well, Lancaster, Tex.		May 9
May 11.	Stone, Pittsburg, Pa. Advertised, Eng. News, Apr. 18 to May 2.		Apr. 18
May 11.	Schoolhouse, Cleveland, O.		Apr. 18
May 11.	Pumping station, Dighton, Kan.		Apr. 25
May 11.	School building, Cleveland, O.		Apr. 25
May 11.	Bridges, Leavenworth, Kan.		Apr. 25
May 11.	Iron fence, Napoleonville, La.		Apr. 25
May 11.	Water tunnel work, Buffalo, N. Y.		May 2
May 11.	Sewers, Cincinnati, O.		May 2
May 11.	Stone paving, Cleveland, O.		May 2
May 11.	Bridge superstructure, Youngstown, O.		May 2
May 11.	Stone paving, Cleveland, O.		May 9
May 11.	Sewer, Cincinnati, O.		May 9
May 11.	School building, Owensboro, Ky.		May 9
May 11.	Sprinkling and sweeping streets, Buffalo.		May 9
May 13.	Plans for court house, Liberty, Tex.		Apr. 11
May 13.	Sewers, Yonkers, N. Y.		Apr. 18
May 13.	Brick paving, Carbondale, Pa. Advertised, Eng. News, Apr. 25 to May 9.		Apr. 25
May 13.	Laying water pipe, New Orleans, La. Advertised, Eng. News, May 2 and 9.		May 2
May 13.	Valve boxes (600), Syracuse, N. Y.		May 2
May 13.	Water-works system, Decatur, Ind. Advertised, Eng. News, May 2 and 9.		May 2
May 13.	Sewer materials, Baltimore, Md.		May 2
May 13.	Test well, Mineral City, O.		May 9
May 13.	Outlet sewer, Rochester, N. Y.		May 9
May 13.	Pipe sewers, Jersey City, N. J.		May 9
May 13.	Sewers, Binghamton, N. Y.		May 9
May 13.	Belgian block paving, Jersey City, N. J.		May 9
May 13.	Brick school building, Elmira, N. Y.		May 9
May 13.	Broken stone, Elmira, N. Y.		May 9
May 13.	Asphalt paving, Persey City, N. J.		May 9
May 14.	Levee (600,000 cu. yds.), Rock Isind, Ill. Advertised, Eng. News, Apr. 18 to May 9.		Apr. 18
May 14.	Coal, Wilmington, N. C. Advertised, Eng. News, Apr. 18 to May 9.		Apr. 18
May 14.	Construction work, B'klyn navy yard.		May 2
May 14.	Paving, Buffalo, N. Y.		May 2
May 14.	Boiler and engine, Tompkinsville, N. Y. Advertised, Eng. News, May 2 and 9.		May 2
May 14.	Brick boundary wall, B'klyn navy yard.		May 2
May 14.	Hydrants and valves, Syracuse, N. Y.		May 9
May 14.	Hospital addition, Richmond, Ind.		May 9
May 14.	Sewers, Philadelphia, Pa.		May 9
May 15.	Smokeless powder, Washington, D. C.		Apr. 4
May 15.	Bridge, Glendive, Mont.		Apr. 4
May 15.	Memorial hall, West Point, N. Y. Advertised, Eng. News, Apr. 11 to May 2.		Apr. 11
May 15.	Plans, etc., for bridge, Montreal Advertised, Eng. News, Jan. 24 and 31.		Jan. 24
May 15.	Barracks, etc., at Fort Myer, Va.		Apr. 18
May 15.	Bonds ($215,000), Schenectady, N. Y.		Apr. 18
May 15.	Telephone franchise, Jackson, Tenn.		Apr. 25
May 15.	Plans for club house, New Orleans, La.		May 2
May 15.	Brick paving, Haughville, Ind.		May 2
May 15.	Distillery, Terre Haute, Ind.		May 2
May 15.	Electric light plant, Orting, Wash.		May 2
May 15.	Dam, etc., Washington, D. C.		May 9
May 15.	Water-wks. ext'ns, Moorhead, Minn.		May 9
May 15.	Sewers, New York, N. Y.		May 9
May 15.	Sheet asphalt paving, Baltimore, Md.		May 9
May 15.	Conveyor, etc., New York, N. Y.		May 9
May 15.	Aquarium at Atlanta, Ga.		May 9
May 15.	Ditch (25 miles), Monticello, Ind.		May 9
May 15.	Electric light plant, Moorhead, Minn.		May 9
May 15.	Addition to jail, Freeport, Ill.		May 9
May 16.	Dredging, Philadelphia, Pa.		Apr. 25
May 16.	School building, Toledo, O.		Apr. 25
May 16.	Steam road roller, Easton, Pa.		May 9
May 16.	Air-lift pumps, Mount Carroll, Ill.		May 9
May 16.	Asphalt paving, New York, N. Y.		May 9
May 16.	Dredging, Portland, Me. Advertised, Eng. News, May 9.		May 9
May 16.	Asphalt paving, Indianapolis, Ind.		May 9
May 16.	Repairing bridge, Springfield, O.		May 9
May 17.	Pipe, etc., and pipelaying, St. Louis.		May 2
May 17.	Building, Pittsburg, Pa.		May 2
May 17.	Stone paving, Brooklyn, N. Y.		May 9
May 17.	Brick paving, Cincinnati, O.		May 9
May 17.	Street improvements, Louisville, Ky.		May 9
May 17.	Iron beams, etc., Pittsburg, Pa.		May 9
May 18.	Stone buildings, at Santa Fe, N. Mex.		Apr. 25
May 18.	Lock, St. Louis, Mo. Advertised, Eng. News, Apr. 18 to May 9.		Apr. 25
May 18.	Remodeling school building, Cleveland, O.		Apr. 25
May 18.	Reconstructing water-wks., Brazil, Ind.		May 2
May 18.	Dike at Everett, Wash.		May 2
May 18.	Brick paving, Wilkinsburg, Pa. Advertised, Eng. News, May 9.		May 9
May 18.	Life saving station at Lake Como, N. J. Advertised, Eng. News, May 9.		May 9
May 18.	Pipe sewers, (9,000 ft.) Des Moines, Ia.		May 9
May 19.	Pipe sewers (14,500 ft.), Waco, Tex.		May 2
May 20.	Water bonds, Santa Clara, Cal. Advertised, Eng. News, Mar. 7 to 28.		Mar. 7
May 20.	Court-house, Wrightsville, Ga.		Apr. 4
May 20.	Street improvements, Fostoria, O.		May 2
May 20.	Brick sewers, Jersey City, N. J.		May 9
May 20.	Court house, Wrightsville, Ga.		May 9
May 20.	Prison extension, Trenton, N. J.		May 9
May 20.	Paving, Elyria, O.		May 9
May 20.	Sewers, Evanston, O.		May 9
May 20.	Gallery, etc., for armory, Niagara Falls.		May 9
May 20.	Fire engine houses (4), Brooklyn, N. Y.		May 9
May 21.	Dredging, Montgomery, Ala. Advertised, Eng. News, Apr. 18 to May 9.		Apr. 18
May 21.	Pumping engines, etc., Brooklyn, N.Y. Advertised, Eng. News, Apr. 11 and 25.		Apr. 11
May 21.	Addition to U. S. bldg., Washington.		May 2
May 21.	Water-wks system, Mount Pulaski, Ill. Advertised, Eng. News, May 2 and 9.		May 2
May 21.	Paving bonds ($4,800), Salem, O.		May 2
May 21.	Brick paving (3,076 sq. yds.), Salem, O.		May 2
May 21.	Brick paving, Frankfort, Ind. Advertised, Eng. News, May 2 and 9.		May 2
May 21.	Brick paving (6,480 sq.yds.), Warren, O.		May 9
May 21.	Sewers, Buffalo, N. Y.		May 9
May 21.	Brick paving (27,000 sq. yds), Canton, Ill. Advertised, Eng. News, May 9.		May 9
May 21.	Cobblestone paving, Brooklyn, N. Y.		May 9
May 22.	Drill hall, Halifax, N. S.		May 2
May 22.	Paving, Hoboken, N. J.		May 9
May 22.	Collecting garbage, etc., Hoboken, N. J.		May 9
May 23.	Water-wks. system, Santa Clara, Cal. Advertised, Eng. News, Mar. 7 to 28.		Mar. 7
May 23.	Public building, at New London, Ct.		May 2
May 23.	New water supply, Schenectady, N.Y. Advertised, Eng. News, May 2.		May 2
May 23.	Bridge, Winnipeg, Man.		Apr. 18
May 23.	Plans for school building, Buffalo, N. Y.		May 9
May 23.	Metal work, Tompkinsville, N. Y. Advertised, Eng. News, May 9 and 16.		May 9
May 24.	Excavating at Newburg, N. Y.		May 2
May 24.	Asphalt paving, Washington, D. C.		May 9
May 25.	Bridge substructure, Cleveland, O.		May 9
May 27.	Dams & shore protections, Miss. River. Advertised, Eng. News, May 2 to 23.		May 2
May 27.	Street improvements, Evanston, O.		May 9
May 28.	Jail, Brazil, Ind.		Apr. 25
May 29.	Machine tools, Watertown, Mass.		May 2
May 29.	Sewer, Cleveland, O.		May 9
May 29.	Brick building, Sherman, Tex.		May 9
May 31.	Pipelaying (50 miles), Syracuse, N. Y. Advertised, Eng. News, May 9 and 16.		May 9
May 31.	Water-works system, Whitehall, Wis.		May 9
May 31.	Pipe sewers (5,000 ft), Findlay, O.		May 9
June 1.	Electric lighting, Vancouver, B. C.		Apr. 25
June 1.	Water-works system, Postville, Ia.		May 2
June 1.	Plans for cotton factory, Weldon, N. C.		May 9
June 3.	Courthouse plans, Winfield, W. Va.		Apr. 18
June 4.	Right to cut timber, Toronto, Ont.		May 9
June 5.	Bridges, Cottonwood Falls, Kan.		May 9
June 7.	Bridge, Versailles, Ind.		Apr. 18
June 7.	Piers, etc., Detroit, Mich. Advertised, Eng. News, May 9 to 30.		May 9
June 10.	Electric light plant, Montreal Que.		May 9
June 15.	Irrigation canal, Portland, Ore.		Apr. 18
July 3.	Bridges, Ukiah, Cal.		Apr. 18
July 8.	Courthouse, Baltimore, Md. Advertised, Eng. News, May 9 to 23.		May 9
Aug. 5.	Plans for state capitol, St. Paul, Minn.		Apr. 25
Oct. 1.	Plans for art building, Philadelphia, Pa.		Apr. 11

RAILWAYS.

East of Chicago.

BLUE MOUNTAIN.—Press reports from Bethel, Pa., state that horses and carts are being collected at that place, 28 miles northwest of Reading, preparatory to commencing work on this railway. The project was described quite fully in a letter from Wm. C. Mayne, Gen. Counsel, published in our issue of Jan. 31. The line between Harrisburg and Reading has been definitely located, and $350,000 worth of work was done on it several years ago. Ch. Engr., Robt. Frazer, 926 Walnut St., Philadelphia.

BUFFALO & SUSQUEHANNA.—It is reported that F. H. & C. W. Goodyear, owners of this road, have purchased the Wellsville, Coudersport & Pine Creek, which extends from Wellsville, N. Y., to Perryville, Pa., 12 miles, and that it will be operated hereafter as a branch of the B. & S. The Buffalo & Susquehanna is being extended from Galeton north to Perryville, 25 miles, and it is stated that several new Baldwin locomotives have been ordered.

CHICAGO, INDIANAPOLIS & CHATTANOOGA SOUTHERN.—This railway has been projected for some years from Rockport to Indianapolis, 172 miles, and was noted in a letter from Rockport, Ind., published in these columns Jan. 31. J. D. Cameron, of Chicago, who is now reported to have the contract for the line between Rockport and Mitchell, 85 miles, began work at Rockport last week. It is stated that subcontracts have been awarded for the entire distance between Rockport and Mitchell, and that the line is to be in operation between those places by June 1, 1896.

Ch. Engr., C. H. Wright, 723 Rookery, Chicago; Pres., F. L. Patrick, Columbus, O.

COUDERSPORT & PORT ALLEGANY.—The contract for the branch line from Coudersport to Ulysses, 23 miles, was awarded May 2 to Geo. S. Good & Co., of Lock Haven, Pa., the work to be completed by Sept. 1, 1895. Secy., Arthur B. Mann, Coudersport, Pa.

DELAWARE & HUDSON.—Efforts are being made to secure an extension of this railway from Caldwell (P. O., Lake George), its present terminus, north to Warrensburg, N. Y., a distance of six miles. H. G. Young, Gen. Man., Albany, N. Y., can give information.

ERIE & CENTRAL NEW YORK.—The Cortland, N. Y., "Standard" states that N. A. Bundy, contractor, of Philadelphia, arrived in town May 1 to make preliminary arrangements for building this railway from Cortland to Cincinnatus, a distance of about 16 miles, and that the first work will be the construction of a bridge over the Tioughnioga River, for which he is already negotiating. This railway is projected from Cortland to Norwich, 35 miles, and was partially graded about 20 years ago. W. M. Messerole, of Brooklyn, surveyed the line last spring.

GLOVERSVILLE & BROADALBIN.—It is reported that the contract for building this railway, noted last week, has been awarded to J. M. Wolf.

LEHIGH AND NEW ENGLAND.—Incorporated in New Jersey, May 2, as a reorganization of the Pennsylvania, Poughkeepsie & Boston; capital stock, $1,500,000; directors, Wm. Jay Turner, Pres.; Wm. B. Scott, Jos. F. Sinnott, John W. Moffly, Wm. W. Gibbs, W. W. Kurtz, and Simon Bfaelzer, all of Philadelphia, Pa.

LEHIGH VALLEY.—It is stated at Lima, N. Y., that the contracts for constructing the Hemlock Lake extension of this railway have been let as follows: From Honeoye Falls, two miles toward Lima, B. P. Smith, of Rochester; to Lima, B. McDonald, of New York; from Lima, three miles south, to Capt. John Shields; to the lake, John F. Dolan, of New York. A large quantity of tools has arrived and operations have begun. The village is full of people looking for work.

LE ROY & NORTHERN.—Incorporated in New York, May 2, to build a standard gage steam railway to connect manufacturing plants in the vicinity of Le Roy, N. Y., with the three trunk lines passing through that village. The right of way is about all secured, and it is stated that the grading will be commenced at once. C. F. Prentice, D. C. H. Prentice, N. B. Keeney and C. N. Keeney, of Le Roy, N. Y., are interested.

LONG ISLAND.—The extension from Bridgehampton to Amagansett has been completed and about 500 men are at work on the line betwen Bridgehampton and Montauk, which is to be completed by July 1.

TILSONBURG, LAKE ERIE & PACIFIC.—We are informed that this is a standard gage steam railway subsidized by Dominion and Provincial grants, and will be constructed this season between Tilsonburg and Port Burwell Harbor, on Lake Erie, a distance of 16 miles. The grading is light and principally of sand. There will be two large bridges across deep ravines. Maximum grade, 1%. Contracts will be awarded, and construction follow immediately upon the completion of the location of the line, now under way. Treas., R. Jenkins, Toronto; Ch. Engr., R. F. Tate, Tilsonburg, Ont.

Southern.

ABERDEEN & WEST END.—This company is reported as building an extension from Candor northwesterly, via Star, to Troy, N. C., about 15 miles, of which four miles are graded. Gen. Supt. and Ch. Engr., J. R. Page, Aberdeen, N. C.

MOBILE, JACKSON & KANSAS CITY.—We are informed that this company has recently had land in the southern portion of Mobile, Ala, condemned, and is now at work clearing up its purchase. It has also secured the right of way from the city over certain streets leading to the river. It is not known how soon work will commence on the construction. Nicol & Ezzell, of Mobile, Ala., are the engineers.

SOUTH ALABAMA AND GULF.—A press report from Dothan, Ala., states that the surveyors in charge of Geo. W. Feagin, of Midway, arrived in that city May 2 and commenced the survey for this railway, which is to run from Dothan to Greenville. It is understood that work commenced at the other end of the line some days ago, and that several miles have already been surveyed. It will take but a short time to complete the survey, after which the projectors state that the construction will be commenced, as the money matters have been arranged.

SOUTHERN.—Col. I. Y. Sage has the contract for grading the double-track lines from Atlanta, Ga., to the exposition grounds.

TAMPA & THONOTOSASSA.—It is reported probable that this railway will soon be extended from Thonotosassa, Fla., to Owensboro. This is operated as the South Florida division of the Savannah, Florida & Western. Supt., R. R. Swoope, Sanford, Fla.

Northwest.

GREEN BAY, WINONA & ST. PAUL.—A. G. Nelson, Mayor of Waupaca, Wis., and a delegation of business men met the officials of this company at Green Bay, Wis., last week, to urge the construction of an extension of the railway from Scandinavia to Waupaca.

WINNIPEG & HUDSON'S BAY.—Hugh Sutherland, Pres., Andrew Strang, Secy., and other officials of this company are reported to have signed a contract with Donald Grant, of Faribault, Minn., and Foley Bros. & Guthrie, of St. Paul, well-known railway contractors, for the construction of 250 miles of this railway north from Winnipeg, within two years. The Manitoba Government is asked to vote $750,000 aid to the Saskatchewan Branch, being one-half the amount voted some years ago provided the road were built to Hudson's Bay within a certain time. The Dominion Government is asked to change its original grant of 6,400 acres of land a mile and $80,000 a year for 20 years, to a loan of $10,000 a mile. This question of rearranging the subsidy is now being considered by the government. Press reports state that the road will be through a prairie country for the entire distance, and that the cost of construction is estimated at $10,000 a mile.

Southwest.

MISSOURI PACIFIC.—Press reports from Lebanon, Mo., state that Jacob Blickensdorffer made his report April 27 to the citizens of Lebanon on the survey of the proposed extension of the Missouri Pacific from Bagnell to Lebanon. He estimates the cost on the most expensive part of the line at $5,000 per mile. About 40 of the 60 miles would be comparatively inexpensive, costing not more than $2,500 per mile, making the average cost of the whole line $3,000 to $3,500 per mile for grading and bridging, exclusive of the bridge over the Osage River, at Bagnell. The report will be submitted to the railway officials.

RED RIVER & SOUTHWESTERN.—The Attorney General of Texas is reported to have granted authority to this company to amend its charter so that a line may be built from a point on or near the Red River, in Clay or Montague county, to run through Young and Haskell counties, and such branches as may be deemed advantageous may be constructed. This proposed line will be 400 miles long, running through the counties of Clay, Montague, Archer, Young, Baylor, Tom Green, Schleicher, Sutton and Edwards.

ST. JOSEPH CENTRAL RY. & TERMINAL.—Hon. W. M. Rusk, J. W. Brockett and W. B. Johnson, of the executive committee, met the citizens of Trenton, Mo., April 27, according to a press report, and talked over the building of a railway to that city. It is proposed to sell Grundy county $30,000 worth of bonds. It is very probable that the road will be built to Pattonsburg, 38 miles, this summer. When the road is finished it will be used by the Quincy, Omaha & Kansas City into St. Joseph, provided the latter management so desires.

THURBER & LLANO COAL & IRON.—Contracts will probably be awarded within a few days for grading this company's line between Thurber and Stephenville, Tex., 28 miles. Henry N. Smith, Stephenville, Tex., has charge of the work.

UNION TERMINAL.—Incorporated in Kansas May 1 to build a railway encircling Kansas City; capital stock, $2,000,000; incorporators, E. L. Martin, A. E. Stilwell, A. A. Mosher and J. H. Pickering, of Kansas City, Mo.; Omar D. Hall, J. J. Spencer and William Thompson, of Kansas City, Kan.; William S. Taylor, of Philadelphia, and E. P. Menwin, of New York.

Rocky Mt. & Pacific.

ALAMEDA & SAN JOAQUIN.—Incorporated in California May 1 to build a railway in Alameda, San Joaquin and Contra Costa counties; capital stock, $500,000, commencing with $30,000; incorporators, John Treadwell, of Oakland; Robt. D. Fry, E. B. Pond, J. Daizell Brown and Brodie M. Bradford, of San Francisco.

SANTA FE, PRESCOTT & PHOENIX.—A press report from Phoenix, Ariz., states that a party of engineers were to start last week from that city locating the line of this railway to Nogales, on the Mexican line, by the way of Florence, Tucson and the Santa Cruz valley. It is understood that contracts have already been placed for the bridges across the Salt and Gila rivers. The extension will be nearly 200 miles in length, but is across a level region, and will be constructed at a minimum expense. It will connect the Atlantic & Pacific railway with the Sonora road, also of the Santa Fe system.

WASHINGTON & COLUMBIA RIVER.—Press reports from Pendleton, Ore., state that an official of this company is authority for the statement that the company contemplates extending its road during the present season. One plan is to build from Dayton, Wash., to Gray City, on Snake River, tapping a productive country. Another plan is to construct a new line from Pendleton to Camas prairie and the John Day region, involving eventual construction through to California, coming into that state at the head of the Sacramento valley, with San Francisco as the objective point. The line to the John Day region has been projected for several years, and it has been a matter of speculation whether the Washington & Columbia River road or the Oregon Railway & Navigation Co. would build it. It would run through Umatilla, Grant, Harney, and Lake counties in Oregon, and enter California at the northern boundary of Modoc county. Theodore Wilcox, Vice-Pres. of the Washington & Columbia River Railroad Co., has gone to Europe, and it is intimated that his visit is to arrange for funds with which to construct the road.

Foreign.

MEXICO.—A special despatch from the city of Mexico says: Hon. Chandos Stanhope, who assisted the government to secure capital for completing the Tehuantepec railway, is in the city from London. Mr. Stanhope contemplates bidding for the construction of the southern and northern ends of the Isthmus railway, which are indispensable for the establishment of transcontinental commerce. The undertaking will also embody the improvement of the harbor of Coatzacoalcos and Salint Cruz and will involve the expenditure of millions of dollars, especially in the construction of the jetties at Coatzacoalcos to make that port accessible to ocean vessels. The concession granted to Enrique Baz June 9, 1891, for a railway from Sierra Mojada to Lampazos, has been amended on the following terms: The line from Sierra Mojada to Jiminez may be extended to include one running from Barrotezan, Coahuila, via Nuevo Laredo, Mier and Camargo to Tampico, with a branch from Santa Teresa to Matamoros. By June 17, 1896, 120 kilometers of the main line must be built; by June 17, 1897, another 120 kilometers, and by June 17, 1898, 130 more, and the rest, with the branches, within the two following years. To aid in the construction of this now famous "Picket Line," the government will pay a subsidy of $9,200 per kilometer for 370 kilometers of the main line; nothing for the branches. The subsidy will be in bonds of the interior debt, issued under the decree of Dec. 6, 1894, and must be received at their face value.

TEHUANTEPEC.—A press report from the city of Mexico, Mex., states that there has been submitted to congress for approval a contract between the Mexican government and Samuel Bros., of that city and New York, for the supply of $2,000,000 worth of rolling stock, bridges and machinery for shops, etc., for the Tehuantepec railway, dredges, tugs and lighters for the harbors and steamship for lighthouse purposes. Samuel Bros. are also negotiating for the construction of the harbors of Coatzacoalcos and Salina Cruz, on the Atlantic and Pacific extremities of the Tehuantepec road.

STREET AND ELECTRIC RAILWAYS.

PORTLAND, ME.—The Portland & Cape Elizabeth Electric Ry. Co. has been granted a franchise for an electric road from Portland to Cape Elizabeth. Clarence Hall is the counsel.

BRIDGEWATER, MASS.—The Brockton & Bridgewater St. Ry. Co., Gen. Man., Harrison A. Rogers, and the Bridgewater & East Bridgewater St. Ry. Co., have applied for franchises for extending their electric roads.

NORTH ADAMS, MASS.—The Hoosac Valley St. Ry. Co. has petitioned for permission to extend its electric line to Williamstown. Pres., C. L. Richmond.

MERIDEN, CONN.—The electric railway company has petitioned for permission to extend its road on a number of streets. Supt., W. C. Gray.

BINGHAMTON, N. Y.—The Binghamton, Lestershire & Union R. R. Co. has petitioned for right of way in Union. Man., J. P. E. Clark.

GENEVA, N. Y.—The Geneva, Waterloo, Seneca Falls & Cayuga Lake Traction Co. has applied for permission to extend its electric railway to Fox's Crossing. Ch. Engr., S. G. Gans.

LITTLE FALLS, N. Y.—Clinton Beckwith, Treas., writes us that the route and line have been adopted and consents of property owners obtained for three-fourths of the assessed valuation for the Little Falls & Herkimer St. Ry. Co.'s electric roads between Little Falls, Jacksonburg, Fort Herkimer and Herkimer, a distance of eight miles. The capital for the construction has been subscribed and the contracts are expected to be awarded in June. Pres., John V. Quackenbush, Mohawk; Ch. Engr., E. T. E. Lansing, Little Falls.

NIAGARA FALLS, N. Y.—The White-Crosby Co., of New York, has sublet the contract for constructing the Buffalo & Niagara Falls Electric R. R. in four sections, as follows: Geo. E. Clark, of New York, from Buffalo to the limits of Tonawanda; second section, through Tonawanda, not yet made known; Nicholas Beckrich, of North Tonawanda, through North Tonawanda; Fred E. Dean, John S. Pierce and Norman Rae, of Niagara Falls, from North Tonawanda to this city. The following contracts have also been awarded: Edwin Terrill, of Niagara Falls, crushed stone; Wheeler & Holden, of Buffalo, ties; Cambria Iron Works, of Johnstown, Pa., rails; J. G. Brill Co., of Philadelphia, motor cars; Jackson, Sharp Co., of Wilmington, Del., open cars; General Electric Co., motors. The work will begin at once and the road be completed by July 1.

WAKEFIELD, N. Y.—The Edenwald St. Ry. Co. has been incorporated to construct an electric railway in Wakefield, West Chester county; capital stock, $50,000; directors, Jefferson M. Levy and G. Waite Tubbs, New York; John M. Digney, White Plains; Matthew C. Lure, Peekskill; Herbert D. Lent and Theodore H. Silliman, Yonkers; George J. Penfield, Wakefield; John Duffy, White Plains, and David H. Hunt, Williams Bridge.

WILMINGTON, DEL.—The Wilmington & Claymont Electric Ry. Co. has petitioned for a charter; capital stock, $100,000; incorporators, Robt. J. Hanby, Amos G. Forwood, Peter Cooper and others.

BALTIMORE, MD.—The Gwynn's Falls Ry. Co. has been incorporated to build a Boynton bicycle railway along the falls in Windsor Hills for a distance of 12 miles; capital stock, $30,000; William J. Dickey, Charles W. Dorsey, J. B. Seth and J. O. Monmonier are interested.

BALTIMORE, MD.—The Central Ry. Co. has petitioned for permission to extend its electric road from Preston and Caroline Sts. to the eastern limits of the city. Supt., J. Hopps.

CLEVELAND, O.—The Cleveland & Painesville Ry. Co. has been incorporated to build an electric railway; capital stock, $200,000; incorporators, John J. Shipherd, M. H. Solloway, Nelson Moses, J. S. Casement, C. O. Child.

COLUMBUS, O.—The Crosstown St. Ry. Co. has been granted permission to extend its electric road. Gen. Man., W. F. Kelly.

ZANESVILLE, O.—The Zanesville & Columbus Electric Ry. Co. has been incorporated to build a road from this city through the counties of Muskingum, Licking and Franklin to Columbus; capital stock, $10,000; incorporators, W. J. Dunzweiler, Albert Adams, A. W. Evans and A. A. Patterson.

CHICAGO, ILL.—The Metropolitan Electric St. Ry. Co. has been incorporated to build a road in the counties of Cook, Du Page, Kane, Lake and Will; capital stock, $5,000,000; incorporators, Robt. P. Parker, Richard E. Breed and James F. Dagley.

INDEPENDENCE, MO.—The Kansas City & Independence Rapid Transit Ry. Co. is considering plans for extending its electric road in this city. Gen. Man., C. F. Holmes.——The Air Line Electric Co. is preparing plans for its railway in this city, according to reports.

GRETNA, LA.—Capt. Thomas Pickles, owner of the Algiers & Gretna St. R. R., has petitioned for permission to change the motive power of the road from horse to electricity.

TOPEKA, KAN.—The Topeka Electric Ry. Co. has been incorporated to build a road between Topeka and Rossville; capital stock, $75,000; incorporators, A. J. Arnold, T. M. James and Francis C. Downey, of Topeka; C. M. Crawford and J. P. Walsh, of Chicago, Ill.

ELECTRIC LIGHT AND POWER.

MONTPELIER V.T.—Jesse S. Viles, proprietor of the Pavilion, has been granted a franchise to light this city by electricity. A dam will be built on the Winooski River, where 1,500 to 2,000 HP. can be developed, which will probably be used to light this city, Barre, Waterbury, Moretown and Middlesex.

HEMPSTEAD, N. Y.—The village improvement society of Lynbrook is reported about to petition the town board to authorize the establishment of a lighting district.

NEW YORK, N. Y.—The Edison Electric Illuminating Co. has voted to issue $15,000,000 in 100-year 5% bonds, $12,000,000 of which is for debts, etc., and $3,000,000 for construction and improvements.

GRETNA, LA.—Gustav Maasa and August Gerdes

have been granted a franchise for electric lights and water-works.

NORWOOD, O.—An election will be held May 13 to vote on a proposition to issue $30,000 in bonds for an electric light plant.

BENTON HARBOR, MICH.—It is reported that work will soon begin on the construction of a dam on the Paw Paw River, one mile north of here. It is proposed to develop 4,000 HP. A company is soon to be incorporated with a capital stock of $1,000,000, $600,000 of which will be paid up. Peter English is interested.

QUINCY, MICH.—It is reported that the question of an electric light plant is being considered.

MOORHEAD, MINN.—Bids are asked until May 15 for an electric light plant with 1,500 incandescent and 80 arc lights. T. I. Lewis, Cy. Recdr.

CONWAY, ARK.—It is stated that an electric light company is being organized.

GROESBEECK, TEX.—F. Allen, of Kosse, is securing subscriptions for an electric light plant.

DELTA, COLO.—Mr. Swan, of Denver, has secured a franchise for an electric light plant, work on which will probably soon be commenced.

RIVERSIDE, CAL.—It is reported that the Redlands Electric Light & Power Co. is negotiating with the trustees in reference to supplying this city with electric light.

MONTREAL, QUE.—Bids are asked until June 10 for a 1,000 incandescent light plant, and for supplying 1,000 lights and four 9-HP. motors. James Patton, Secy. Com. Montreal General Hospital.

NEW COMPANIES.—Hamacek Electric Light, Power & Heating Co., Sturgeon Bay, Wis.; $25,000.

Northern Water-Works & Power Co., Beresford, S. Dak.; $75,000; A. L.Potter, C. A. Potter.

Western Light & Power Co., Kansas City, Mo.; $3,000; C. A. Gray, L. A. Hull, E. F. Littleton.

Mammoth Spring Electric Light & Power Co., Little Rock, Ark.; $100,000, with $10,000 paid in; H. G. King, W. D. Cook, M. J. King.

Chapin-Douglas Electric Co., New York, N. Y.; $10,000; to deal in electrical apparatus; Chas. E. Chapin, Greenwich, Conn.; John S. Douglas, Frederick F. Douglas, New York.

Hackensack Edison Lighting Co., Hackensack, N. J.; $25,000; Pres., Frank B. Poor; Secy., William C. Thomas; H. Ward Leonard, Joseph F. Moshier, New York; Alfred O. Tate, West Orange.

Kearny Electric Light & Power Co., Kearney, N. J.; $50,000, with $1,000 paid in; Geo. F. Woolson, Jr., 40 Wall St., New York; Bertram C. Smith, 98 Lincoln Place, Brooklyn; Joseph Randall, Kearney.

Utah Power Co., Salt Lake City, Utah; $1,000,000; to develop and transmit 3,000 HP. from the Big Cottonwood River; R. C. Chambers, John E. Dooly, Richard Mackintosh, Francis Armstrong, A. W. McCune.

BRIDGES.

DURHAM, ME.—The town has voted to issue $5,000 in bonds to build an iron bridge across the Androscoggin River to Lisbon.

HOLLIS, ME.—The town has voted to issue $10,000 of 4% bonds for rebuilding two iron bridges destroyed by high water.

NATICK, MASS.—The construction of bridges at the Main St. crossing, estimated to cost $14,000, is being considered.

CORTLAND, N. Y.—The Erie & Central New York Ry. Co. is reported about to contract for a railway bridge near this city, as noted under Railways.

ELMIRA, N. Y.—The city has voted to issue $110,000 in bonds for building two highway bridges.

NIAGARA FALLS, N. Y.—The city has been notified by the Schoellkopf Canal Co. that it will have to rebuild its bridge across the canal to enable the company to widen the canal to 100 ft. The bridge will cost about $8,000.——The construction of a new bridge across Gill Creek, estimated to cost $5,200, is being considered.

SYRACUSE, N. Y.—The governor has signed the bill appropriating $8,000 for a bridge over the inlet to Otsego Lake, Onondago county.

McKEESPORT, PA.—The Allegheny & Westmoreland Bridge Co. has been incorporated to build a bridge over the Youghegheny River from Elizabeth township, near the mouth of Douglass Run, to Suterville, Pa.; capital stock, $1,000; Treas., Ira J. Wilson, Pittsburg.

GAINESVILLE, GA.—The following bids were received April 25 for constructing a bridge across the Chattahoochee River:

Pennsylvania Steel Co., Steelton, Pa.	$4,990
Iron Substructure Co., Columbus, O.	4,990
Jasper Construction Co., Jasper, Ala.	4,910
Columbus Bridge Co., Columbus, O.	4,990
Lombard Co., Augusta, Ga.	4,800
Steel & Iron Bridge Co., Knoxville, Tenn.	5,000
Watkins & Hardaway, Birmingham, Ala.	4,840
Brady Steel Bridge Co., Chattanooga, Tenn.,	5,100
W. H. Converse Co., Chattanooga.	4,825
Alabama Bridge Co., Anniston, Ala.	4,425

KNOXVILLE, TENN.—W. A. Park, Cy. Engr., and J. C. Wright, of Knoxville, have prepared plans for a stone bridge 1,750 ft. long across the Tennessee River at Gay St., and a bill authorizing Knox county to issue bonds for the construction has passed the legislature.

NEWPORT, KY.—The Louisville & Nashville R. R. Co. has prepared plans for rebuilding its bridge across the Ohio River between Cincinnati and Newport, at an estimated cost of $1,000,000.

CLEVELAND, O.—The council is considering the question of constructing a bridge over the railway tracks at Willson Ave., at an estimated cost of $70,000.

CLEVELAND, O.—Bids are asked until May 25 for constructing the substructure of the bridge across the Chagrin River at Bentleyville. Julius C. Dorn, Clk. Bd. County Comrs.——Press reports state that the Cleveland, Lorain & Wheeling R. R. Co. has awarded the contract for 20 steel bridges to be placed on the road south of Ulrichsville, two-thirds to the Carnegie Steel Co., to be built at the Keystone Bridge Works, and one-third to the King Bridge Co., of Cleveland. The contract for the masonry was awarded to Hallock Bros., Wheeling, W. Va.

IRONTON, O.—The construction of an iron bridge 200 ft. long across Storms Creek, at Elm St., estimated to cost $6,200,is being considered. L. M. Henry and W. A. Murdock are on the committee appointed to act with the engineer in preparing plans and advertise for bids.

MASSILLON, O.—The county commissioners have been petitioned to build bridges across the canal and the river at Columbia Heights.

SPRINGFIELD, O.—Bids are asked until May 16 for repairing the bridge over Buck Creek, at Spring St. S. J. Wilkerson, Cy. Clk.

GALESBURG, MICH.—It is reported that a township meeting will soon be called to consider plans for a new bridge, which was voted for last year.

PEORIA, ILL.—It is reported that Jubilee and Hollis townships have petitioned the supervisors of Peoria county to aid in building new bridges.

COLUMBIA, WIS.—The supervisors have recommended the construction of an iron bridge.

MARSHALLTOWN, IA.—It is reported that the Iowa Central R. R. Co. will replace all its bridges between Albia and Eddyville with steel structures. Gen. Man., L. M. Martin, Marshalltown.

TAYLORS FALLS, MINN.—Estimates are being made for a free bridge across the St. Croix River, at the foot of the Rapids. Benjamin Clayton, of Taylors Falls, and L. B. Dresser, of St. Croix Falls, are interested.

BELOIT, KAN.—John Hyde is securing signatures to a petition to be presented to the county commissioners asking for a bridge across the Soloman River.

COTTONWOOD FALLS, KAN.—Bids are asked until June 5 for building a double arch bridge across the Cottonwood River, at Forman Crossing, and for the superstructure of a 110-ft. span iron bridge. M. K. Harman, County Clk.

BUILDINGS.

ALBANY, N. Y.—It is reported that a Chicago syndicate, represented by Philo D. Beard, has purchased the site of the Delavan House, which was destroyed by fire last December, on which it is proposed to erect a 10-story hotel, to be completed by next January.

BROOKLYN, N. Y.—Bids are asked until May 20 for building four fire engine houses. F. W. Wurster, Comr. Fire Dept.

BUFFALO, N. Y.—Plans are asked until May 23 for a high school building on Masten St. R. G. Parsons, Secy. Dept. Pub. Wks.——Green & Wicks, Archs., have prepared plans for a three-story brick and stone club house for the Twentieth Century Club at 595 Delaware Ave., to cost $40,000.——Geo. B. Matthews has obtained from the bureau of building a permit to build a six-story brick building with steel framework at 391 Main St., to cost $90,000. The same architects prepared the plans.——Green & Wicks have prepared plans for a seven-story brick flat building to be built for S. E. Laird at the northeast corner of Main and Utica Sts., to cost $175,000.

ELMIRA, N. Y.—Bids are asked by the board of education until May 13 for constructing a 12-room brick school house. Arch., J. H. Considine, 502 Robinson Bldg.

HORNELLSVILLE, N. Y.—The construction of a combined court house and city hall, estimated to cost $25,000 to $30,000, is being discussed.

NEW YORK, N. Y.—Plans have been filed by William J. Merritt, 339 Boulevard, for a seven-story brick flat at West End Ave. and 81st St., to cost $400,000, and by Maurice Aron, 58 West 92d St., seven-story brick flat, Amsterdam Ave. and 79th St., to cost $100,000.

NIAGARA FALLS, N. Y.—Bids are asked until May 20 for erecting a gallery, mezzanine floor and ceiling of drill hall at the state armory building. Arch., I. G. Perry, Capitol Bldg., Albany;Adj. Gen. E. A. MacAlpin, Capitol, Albany.

SYRACUSE, N. Y.—Plans have been prepared by H. S. Newton, Ch. Engr. Syracuse St. Ry. Co., for a two-story brick barn 160 × 160 ft., with a capacity of 150 cars, estimated to cost about $50,000.

TRENTON, N. J.—Plans are asked until May 20 for a wing to the state prison, to contain 200 cells, and a hospital. E. J. Anderson, Pres. State Prison Bldg. Comn.; E. H. Holcombe, Lambertville; Henry Dickson, 22 Clinton St., Newark.

PITTSBURG, PA.—Bids are asked until May 17 for excavating and making alterations in cellar walls and for furnishing 16 cast iron beams and four steel beams upon which to erect a floor in the fire engine house on Second Ave. J. O. Brown, Dir. Dept. Pub. Safety.——It is reported that D. F. Henry, Pres. Federal St. & Pleasant Valley Ry. Co., is about to erect a 10-story stone hotel at 125 and 127 Fifth Ave., estimated to cost over $100,000. Archs., Longfellow, Alden & Harlow.——The following contracts have been awarded for the construction of the new shops for the Westinghouse Machine Co. at East Pittsburg, estimated to cost $400,000, the work to be completed by Nov. 1: Fred Gwinner, Pittsburg, stone work; Steele & Hall, Pittsburg, brickwork; George Hogg, Pittsburg, carpenter work; Keystone Bridge Works, Pittsburg, structural steel; T. W. Irwin, Allegheny, galvanized iron and skylights; Aiken & Co., Pittsburg, slating; Cluley & Sons, Pittsburg, painting; McFadden & Craig, Pittsburg, plumbing.

BALTIMORE, MD.—Bids are asked until July 8 for constructing a new court house for this city, as stated in our advertising columns. Archs., Wyatt & Nolting, 4 East Lexington St.; F. C. Latrobe,, Mayor, Chn. Com.

WASHINGTON, D. C.—Bids are asked until May 18 for rebuilding the Spring Lake life-saving station, Lake Como, N. J., as stated in our advertising columns. S. I. Kimball, Gen. Supt.——Press reports state as follows: The bureau of American republics is informed that the government of the Argentine Republic has decided to invite bids from architects throughout the world for plans of a new building intended for use of congress. Three prizes will be offered for the best design—one of $20,000, one of $10,000 and one of $5,000. The architect receiving the first prize will be given the execution of the work. The prizes will be paid in the paper currency of the country, based on its value on Oct. 12 next, the last day upon which plans can be submitted. The Argentine dollar is worth at this time in United States gold about 24 cts.

WELDON, N. C.—Plans are asked by the United Industrial Co., 120 Broadway, New York, until June 1, according to reports, for erecting and equipping a cotton factory of 30,000 spindles and 1,200 looms capacity. The building will be three or four stories high. A set of turbine wheels to generate 200 HP. will be put in.

WRIGHTSVILLE, GA.—Bids are asked until May 20 for building a court house for Johnson county. J. M. Hightower, Chn.; J. H. Hicks, Secy.

SELMA, ALA.—It is reported that a cotton mill, estimated to cost $100,000, is to be constructed. Ernest Lamar is interested.

OWENSBORO, KY.—Bids are asked until May 14 for the erection of a school building; Archs., Drach, Thomas & Bohne, Louisville; James J. Sweeney, Pres. Bd. Education.

NORWOOD, O.—An election will be held May 13 to vote on the question of issuing $50,000 in bonds for a city hall.

RICHMOND, IND.—Bids are asked until May 14 for erecting an addition to the Eastern Indiana Hospital for the Insane, estimated to cost $50,000. Arch., John A. Hasecoster.

SEYMOUR, IND.—It is reported that the Bilsh Milling Co. is putting in a large suction wheat fan and also making preparations for a large steel elevator, 40 ft. in diameter and 50 ft. high, which will hold 210,000 bushels.

DETROIT, MICH.—D. H. Burnham & Co., of Chicago, are preparing plans for a 14-story brick and granite store and office building, at Woodward and Michigan Aves., estimated to cost $700,000. Benjamin Hyde, Jesse B. Farwell and M. H. Godfrey are interested.

CHICAGO, ILL.—J. G. Glaver & Co., 1003 Monadnock Block, have been awarded the contract for furnishing all material and building the Beck block, at 91st St. and Commercial Ave., South Chicago. It is to be an office, public hall and store building, 68 × 25 ft., four stories high. The cost of the ironwork will be $10,000, and of the woodwork $15,000. Work is to be commenced at once.

FREEPORT, ILL.—Bids are asked until May 15 for constructing juvenile and female apartments for the county jail. J. N. Galloway, Comr. Pub. Bldgs.

AUSTIN, MINN.—Isader Longini and Geo. W. Thoms, of Mankato, are reported to have completed arrangements for a brick business block to have 30,000 sq. ft. of floor space.

TOPEKA, KAN.—It is reported that $50,000 has been appropriated to be used at once toward completing the capitol, and that $175,000 will be available next year.

ST. LOUIS, MO.—Henry I. Cobb, of Chicago, is preparing plans for a 17-story bank, store and office building at Eighth and Olive Sts. for the Olive Bldg. Association, estimated to cost $700,000. J. C. Richardson, Pres., Chemical National Bank; Jacob Christopher, of the Christopher & Simpson Iron Works, and W. T. Simpson are interested.

SHERMAN, TEX.—Bids are asked until May 29 for constructing a three-story brick building. Arch., Thomas Wood.

PORTLAND, ORE.—The following bids have been received by Major Post for the erection of the Willamette River light station, which is to consist of a small lighthouse and fog signal at the junction of Columbia River with the Willamette River:

Lewis C. Shorno, Portland	$3,200
W. S. Bruce, Portland	2,680
Richard Hoyt, Portland	6,500
A. G. Shepard, Portland	2,985
Dan McCotter and J. S. Cunningham	3,265
T. H. Walsh, Portland	4,375
Patch & Pine, Portland	2,826
Thos. Wilson, Portland (awarded contract)	2,675
Chas. Freedner, Portland	3,495
Martin G. Clancy, Portland	4,569
Charles Carmichael, Portland	3,529
Merchant & Findley, Portland	3,500
W. Jacobsen, Portland	3,146
F. T. Sherman, Tacoma	4,792
James Reid, Portland	3,431
E. G. Worth, Portland	2,998
John Foott, Portland	4,973
Nichols & Crothers, Tacoma	3,625
Robert Smith, Portland	4,643
Spore & Robinson, Portland	2,800
C. P. Wakeman, Portland	3,475
D. P. Marsh, Oregon City	4,719
Honnes & Nelson, Portland	2,925

WATER-WORKS.

WILTON, ME.—J. E. Hiscock, Town Clk., writes us that the Wilson Lake Water Co. has been incorporated and will put in works estimated to cost about $2,000. It is probable that the work will be done by the company. Cyrus Henderson and H. H. Houghton are directors.

NEW HAMPTON, N. H.—Frank P. Morrel, Town Clk., writes us that the water-works project has not sufficiently developed to give any definite information.

BENNINGTON, VT.—At a village meeting April 30 it was voted to purchase the plant of the Bennington Water Co., at a cost not to exceed $125,000.

HATFIELD, MASS.—W. D. Billings, Town Clk., writes us that nothing has been done on the proposed water-works since the survey of last November, and it is not probable that anything further will be done until next year.

MAYNARD, MASS.—It is reported that $4,000 has been appropriated for a 200,000-gallon receiving well.

RUTLAND, MASS.—Louis M. Hauff, Town Clk., writes us that the town has applied to the legislature for right to secure a water supply from certain lakes, but that no other action has been taken.

WEBSTER, MASS.—L. A. Taylor, of Boston, has been engaged to make plans for the new water supply.

SOUTHPORT, CONN.—Marsh, Merwin & Lemmon, bankers, of Bridgeport, Conn., write us that surveys

have been made for works, and that the legislature has been petitioned for a charter for the Southport Water Co.

ANTWERP, N. Y.—T. T. Ballard, Clk., writes us that the vote to appropriate $30,000 for works was nearly unanimous. No surveys have yet been made. Pres. Comrs., E. D. Perley; Secy., G. W. Hall; Treas., A. Hoyt.

BALLSTON SPA, N. Y.—W. L. Grose, Village Clk., writes us that an engineer has been engaged to look over the present system and make a report on the enlargement of the present works or the construction of a new system, which will give a sufficient supply of water in all parts of the village. It is not probable that anything will be done at present, as no appropriation has yet been voted.

CLIFTON SPRINGS, N. Y.—L. M. Bement, Clk., writes us that no steps have yet been taken for works.

CORNING, N. Y.—W. L. McGeorge writes us that the matter of improving the works is now in the hands of the legislature. No election has yet been called to vote on the question.

FREDONIA, N. Y.—The governor has signed a bill authorizing this city to issue $20,000 in bonds for improving the water supply.

LAURENS, N. Y.—It is reported that works may be put in by ex-Supervisor Widger, who owns the water privilege at Gilberts Lake.

LOWVILLE, N. Y.—An election will be held May 16 to vote on an issue of $5,000 in bonds for a storage reservoir.

PHILMONT, N. Y.—Geo. W. Vedder, Village Clk., writes us that steps will soon be taken to secure works, but that nothing has yet been done.

MOUNT VERNON, N. Y.—It is reported that efforts are being made to have this village, Port Chester, Rye and other places along the Sound join in securing an increased water supply from the vicinity of Greenwich, Conn.

RHINEBECK, N. Y.—The clerk writes us that no works are contemplated at present.

ROCKVILLE CENTER, N. Y.—Winfield S. Davison, of Rockville Center, has been engaged to take charge of the construction of works, for which surveys will be made at once. It is expected that about five miles of pipe will be laid, and that the water supply will be pumped to a 20 × 100-ft. stand-pipe.

SAUGERTIES, N. Y.—J. Deterick, Clk., writes us that nothing definite has yet been decided upon regarding works.

SYRACUSE, N. Y.—Bids are asked until May 14 for a supply of hydrants and stop gates; also until May 31 for laying about 50 miles of 36 to 6-in. pipe, as stated in our advertising columns. W. R. Hill, Ch. Engr.

TULLY, N. Y.—The village clerk writes us that nothing has yet been done, and that it will probably be one or two weeks before water commissioners are appointed.

UNIONVILLE, N. Y.—An election will be held May 16 to vote on an appropriation of $900 for water for fire protection for three years, $320 to be paid each year.

EGG HARBOR CITY, N. J.—The Egg Harbor Water, Electric Light & Power Co. has been organized, and is reported to have awarded the contract for constructing works to W. W. Taylor. Pres., Dr. T. H. Boysen.

WILDWOOD BEACH, N. J.—It is reported that the construction of works to cost $25,000 will soon be commenced, the water supply to be from an artesian well.

ALTOONA, PA.—C. A. Martin, Secy. Comrs., writes us that the contract for constructing a flood water channel, as advertised in Engineering News, has been awarded to Jutte & Foley Co., the bids being as follows:

M. H. Smith, Altoona, Pa.	$64,350
D. F. O'Rorke, Altoona, Pa.	47,995
Herr & Flinn, Altoona, Pa.	39,236
Collins & Martin, Altoona, Pa.	51,444
Bennett & Talbot, Greensburg, Pa.	62,516
Bowman Bros., Altoona, Pa.	34,882
Jutte & Foley Co., Pittsburg, Pa.	34,580
Pennock & Vipond, Altoona, Pa.	52,761
W. G. Stahl & Sons, Altoona, Pa.	41,689

CARBONDALE, PA.—The Crystal Lake Water Co. is laying about 2,800 ft. of 8-in. pipes on Belmont St., in advance of the paving of that street, and will continue for about 2,600 ft. of 8-in. pipe for the water supply of Klots Bro's. silk mill, just outside of the city limits. Land has been acquired for an impounding reservoir, with an area of 100 acres, to be built this summer. An appropriation of $30,000 was made for these.——The Newton & Fall Brook Water Co. is laying about 2,000 ft. of 8-in. pipe in a new division of the city recently opened.

CRESSON, PA.—R. Devereaux, owner, writes us that, owing to temporary difficulty in procuring right of way, the construction of works has been temporarily suspended; supply from springs; population, 400.

DRIFTWOOD, PA.—The question of works is reported as again being agitated.

HAZLETON, PA.—Press reports state that the citizens will soon vote on an issue of $210,000 in bonds for water-works.

MOUNT CARMEL, PA.—A. B. Cochran & Son, of Pottsville, are reported as making surveys for a new reservoir at this place.

NEW HOLLAND, PA.—Edgar B. Kay, of Bellwood, Pa., has been awarded the contract for constructing works at this place, as noted under Contract Prices.

NORWOOD STATION, PA.—At an election, April 30, the citizens voted to issue $30,000 in bonds for water-works and sewers, according to press reports.

SUSQUEHANNA, PA.—D. J. Lynch, Secy., writes us that no steps have yet been taken for proposed works.

WASHINGTON, PA.—J. Mac. Jones, Supt. Citizens' Water Co., writes us that bids will be received until May 15 for the construction of a new dam for an impounding reservoir to cover 33 acres, with 6,800 ft. of pipe line. Engr., John J. Ruple.

HYATTSVILLE, MD.—E. L. Latimer writes us that works will probably be put in soon, but that the town charter will have to be amended before contracts can be awarded. The supply will probably be from an artesian well; population, 2,000.

NORFOLK, VA.—The only bid received for establishing a gang-well auxiliary water system, capable of supplying 2,000,000 gallons a day, according to the specifications, was that of the National Artesian Well Co., at $19,000, and this was rejected.

WAYNESBORO, VA.—W. N. Fishburne, Chn. Com., writes us that the town will vote bonds for works to cost about $20,000. It has not been decided where the water supply will be obtained, but if by gravity it will probably be secured within a distance of five miles. It is probable, however, that a 1,000,000-gallon pump will be purchased and the supply taken from a large spring.

LAKE STATION, N. C. (Not a post-office).—Bids are asked for the construction of a small water-works plant and five cottages at this place. Address T. W. Marriott, Builders' Exchange, Charles and Lexington Sts., Baltimore, Md.

BUENA VISTA, GA.—C. Horace McCall writes us that this village is talking of putting in works to cost $5,000 to $10,000. It is proposed to pump the supply from wells with rams.

COCHRAN, GA.—An artesian supply of more than 40 gallons per minute is reported to have been secured. The work has been in progress over a year.

CAMBRIDGE, O.—An election will be held June 3 to vote on an issue of $60,000 in bonds for the construction of works. The plans include 53,000 ft. of 14 to 4-in. mains, a 25 × 60-ft. stand-pipe and two 1,000,000-gallon duplex pumping engines. Consult. Engr., E. C. Cooke, Cleveland, O.; Cy. Engr., O. M. Hoge.

LOGAN, O.—B. K. Fritsch, Secy., writes us that the water bonds will be sold May 9, and that the contract for constructing works will not be awarded before June 25, or later; no engineer has yet been engaged; population, 3,500.

MINERAL CITY, O.—Bids are asked until May 13 for drilling a 6-in. test well 200 to 1,000 ft. deep. Thos. Edwards, Cy. Clk.

WAPAKONETA, O.—George Hornung, of Cincinnati, has been engaged as consulting engineer of the proposed works at this place.

WESTWOOD, O.—The council is reported to have passed an ordinance providing for an issue of $20,000 in water supply bonds.

GARRETT, IND.—The city clerk writes us that an election will be held May 20 to vote on the question of works; population, 3,500.

HAGERSTOWN, IND.—J. M. Hartley, Town Clk., writes us that the question of works is being agitated by some of the citizens, but that it is not probable that anything will be done this summer.

MICHIGAN CITY, IND.—It is reported that an election will soon be held to vote on an issue of $20,000 to $30,000 in bonds, to secure a better water supply.

PORTLAND, IND.—This city is reported to have purchased the works and electric light plant for $65,000.

LAKE ANN, MICH.—The residents of this village have voted to issue $4,000 in bonds for works, which will be constructed at once. The supply will be secured from a brook.

OXFORD, MICH.—We are informed that the contracts for constructing works and an electric light plant were awarded on April 14. Engr., W. H. Ashwell, Detroit, Mich.

WESTON, MICH.—The business men are reported as about to put in works for fire protection.

MOUNT CARROLL, ILL.—Bids are asked until May 16 for an air lift pump to pump not less than 500 gallons of water per minute. T. E. Becker, Chn. Com.

PARIS, ILL.—Bids were received May 7 for the construction of a dam for a better water supply, for which George H. Simson, Terre Haute, Ind., has prepared plans.

JUNEAU, WIS.—The citizens have voted to issue $4,500 in bonds for works.

WHITEHALL, WIS.—Bids are asked until May 31 for the construction of works, estimated to cost $6,000. C. P. Thompson, Village Clk.

CENTERVILLE, IA.—The Centerville Water Co. has been incorporated by W. M. Platman, James Merritt, J. P. Miller and others, with a capital stock of $100,000.

COLUMBUS JUNCTION, IA.—It is stated that works will be put in at once. No engineer has yet been engaged. E. T. Foster, Cy. Recdr.

DAYTON, IA.—W. L. Burnett, Recdr., writes us that the contract for constructing works has been awarded to the U. S. Wind Engine & Pump Co., of Batavia, Ill., and that the bonds have been sold to W. W. Harris & Co., of Chicago.

HARLAN, IA.—M. Fretz, Cy. Recdr., writes us that the contract for the proposed extensions has been awarded to the Fremont Foundry & Machine Co., Fremont, Neb., at $4,445. B. P. Egan, of Nebraska City, Neb., bid $4,985, and the U. S. Supply Co., of Omaha, $5,199.

MANCHESTER, IA.—It is reported that work was to commence this week on an artesian well for a better water supply.

PAULLINA, IA.—The contract for constructing works has been awarded to A. F. Paige.

REMSEN, IA.—An election will be held May 27 to vote on an issue of $3,900 in bonds for works.

SIOUX CITY, IA.—It is stated that a new pumping station, to cost $40,000 to $50,000, is needed.

MOORHEAD, MINN.—Bids are asked until May 15 for extensions and for a new engine. The pumps will be moved to a new building, and about 4,000 ft. of new mains laid. Engr., M. Daunaher, of Moorhead. T. I. Lewis, Cy. Recdr.

PRINCETON, MINN.—Plans are being made for works and an electric light plant.

SHERBURNE, MINN.—H. H. McGovern, Village Recdr., writes us that $10,000 in bonds have been voted for works, and that C. F. Loweth, of St. Paul, is preparing the plans.

ST. PAUL, MINN.—Contracts for laying water pipe have been awarded to Patrick Daugherty at $3,743, and Million & Young, at $1,054 and $6,222, the bids being as follows:

	Div. 1.	Div. 2.	Div. 3.
P. H. Thornton	$6,872	$3,411	$8,068
Dale & Baumgarden	7,886	2,117	7,795
N. Fegen	4,480	1,934	6,420
Million & Young	4,506	1,054	6,222
John Swanstrom	6,336	3,312	7,662
E. T. Winston	6,742	1,917	8,007
J. D. Moran	3,971	1,056	8,400
Thomas Reiley	4,810	.....	7,496
James Forrestal	4,924	.....	*5,630
Patrick Daugherty	3,743	2,202	*2,942

* Portions of the work only.

CHANUTE, KAN.—J. W. Buchanan, Clk., writes us that $40,000 in water bonds will be voted upon May 10 to complete the works. M. J. Jones, Chn. Com.

BERESFORD, S. DAK.—The Northern Water-Works & Power Co. has been incorporated, with a capital stock of $75,000, by A. F. Potter, C. A. Potter and others.

FORT PIERRE, S. DAK.—A franchise for works has been granted to C. L. Mellett, construction to be commenced May 15.

COLEMAN, TEX.—A contract for works has been awarded to J. M. Carter, of Bowie.

CORPUS CHRISTI, TEX.—The legislature has passed a bill granting the Corpus Christi Water Supply Co. the right to construct a dam in the Nueces River.

LANCASTER, TEX.—Bids are asked until May 10 for sinking an artesian well. S. L. Randlett, Chn. Com.

LOMETA, TEX.—Efforts are being made to raise money to put in works.

MORGAN, TEX.—Morton & Little, who have the franchise for works, will soon be in the market for five or six miles of pipe.

RICHMOND, TEX.—The commercial club has appointed a committee to organize a company to put in works.

SMITHVILLE, TEX.—The Smithville Water & Light Co. has been incorporated, with a capital stock of $40,000, by K. H. McCaskill and others.

NEWKIRK, OKLA.—H. S. Brauchi, Cy. Clk., writes us that there is talk of constructing works, the water supply to be pumped from a spring to a stand-pipe, but that nothing can be done until the spring assessment is returned, after which the question of issuing bonds may be voted upon; population, 1,500.

PAWHUSKA, OKLA.—Bids will soon be asked for constructing works at the Osage Indian Agency. Lieut.-Col. H. B. Freeman, Acting U. S. Indian Agt.

SALT LAKE CITY, UTAH.—The Twenty-third Ward Water Supply Co. has been incorporated, with a capital stock of $20,000, to furnish water in the Twenty-third ward; incorporators, F. S. Fernstrom, H. B. Folsom and others.

ARROYO GRANDE, CAL.—The Arroyo Grande Water Co. has been incorporated with a capital stock of $10,000, commencing with $2,950; incorporators, G. O. Taylor, A. W. Dixson, C. A. Pitkin and others.

AZUSA, CAL.—The Contract Water Company of Azusa has been incorporated with a capital stock of $8,000, commencing with $5,000; incorporators, R. W. Dason and C. T. Robedeau, of Glendora, and J. T. Gordon, S. C. Headley and T. F. Griswold, of Azusa, Los Angeles county.

LOS ANGELES, CAL.—An election was held May 3 to vote on an issue of bonds, including $30,000 for acquiring land for head works for a water system.

LENNOXVILLE, QUE.—It is stated that a 25-year franchise for works has been granted to Montreal parties.

WESTVILLE, N. S.—It is reported that contracts for works have been awarded as follows: J. K. McDonald, of New Glasgow, for the excavation; Londonderry Iron Works, for the pipe; Mr. Northey, of Toronto, for pumps; Mr. Robb, of Amherst, for boilers; Mr. Weir, of Westville, for castings, and Mr. Brown, of New Glasgow, for hydrants.

IRRIGATION.

TOPEKA, KAN.—Press reports state as follows: The state board of irrigation has awarded the following contracts for the erection of four experiment stations: Station No. 1, located four miles north of Kendall, Hamilton county, will be equipped with a windmill plant, to cost $795. The contractors are the Stover Mfg. Co., of Freeport, Ill. Station No. 2, Gray county, five miles south of Cimarron, in the sandhill country, will also be equipped with a windmill. The plant will cost $555, and will be built by Crane & Co., of Kansas City, Kan. Station No. 3, located five miles south of Ulysses, is also to be a windmill station. It is to be equipped by Woodmanse & Hewett, of Freeport, Ill., for $755. Station No. 4, Goodland, Sherman county, is to be equipped with a gasoline engine of 10 HP. and a pump with a capacity of 100 gallons a minute. Fairbanks-Morse & Co., of Kansas City, will put in the plant at Goodland, to cost $1,500. Stations will also be established in Logan, Wichita and Greeley counties.

CHEYENNE, WYO.—Press reports state that there are three ditches taking water from the Platte River in the vicinity of Wheatland, and are owned as follows: First, by Torrington Ditch Co., Pres., Wm. G. Curtis; Secy., John Cameron. This ditch is 10½ miles long and will irrigate 3,000 acres. Second, by North Platte Irrigation Ditch Co., Pres., Oscar Mason; Secy., Wm. R. Coy. This ditch is 13 miles long and will furnish water for 4,500 acres. Third, the Lucerne Canal Co., Pres., Colonel Pratt; Secy., Henry Hudson. This ditch is 13¾ miles in length and covers 5,000 acres.

SALT LAKE CITY, UTAH.—Press reports state that the Marysvale Reservoir Co. has been incorporated for some time past, with a capital stock of $300,000, and its objects were to store the water of the Sevier River around Marysvale, and construct canals on either side of the river to convey the waters to the arid valleys between Marysvale and Richfield. The site for the dams has been selected and some work done, and it is now the intention of the management to use the new capital in completing the dams and digging canals on either side of the river. The new project will bring 35,000 acres of dry lands under cultivation. Joseph A. Brown, of Chariton, Ia., is interested.

NEW COMPANY.—Rawson Ditch Co., Bishop, Inyo county, Cal.; $40,000, with $37,000 paid in; to construct

irrigating ditches; G. W. Rawson, R. W. Ford, T. F. A. Connelly, T. W. S. McLeod, G. P. Bowland.

SEWERAGE.

BRADFORD, VT.—Surveys have been completed for a system, estimated to cost about $8,000.

QUINCY, MASS.—An ordinance has been introduced in the council appropriating $500 for investigating the question of a system.

AVON, N. Y.—A system to cost $12,000 is to be put in, according to reports.

BABYLON, N. Y.—Press reports state that the question of constructing a system is being agitated, and the trustees have appointed as a commission John R. Reed, W. F. Norton, James H. Arnold, T. Prior Weeks and F. A. Dowden. What method will be employed is not yet known, but it is probable that the system will be constructed during the summer. Oscar Darling is preparing plans.

BINGHAMTON, N. Y.—Bids are asked until May 13 for constructing sewers in three streets. Lewis Seymour, Cy. Clk.——The city engineer has been directed to prepare plans for sewers in four streets.

BUFFALO, N. Y.—Bids are asked until May 21 for constructing 18 to 10-in. pipe sewers in four streets, and a 24 and 21-in. brick sewer in one street. R. G. Parsons, Secy. Dept. Pub. Wks.

FLUSHING, N. Y.—The board of health has directed the trustees to build a sewer in Garden St. and to repair a number of other sewers.

ITHACA, N. Y.—At an election April 30 the city voted to issue $150,000 in bonds for sewers. Engr., James W. Reed.

NEW YORK, N. Y.—Bids are asked by the commissioner of public works until May 15 for constructing sewers in three streets and for altering sewers in Columbus Ave.

PELHAM MANOR, N. Y.—An election will be held May 11 to vote on the question of constructing sewers, estimated to cost $30,000 to $40,000. F. Carles Merry, Chn. Comrs.

ROCHESTER, N. Y.—Bids are asked until May 13 for constructing an outlet sewer. T. J. Neville, Clk.

JERSEY CITY, N. J.—Bids are asked until May 13 for constructing 675 ft. of 18-in. pipe sewers, etc., and until May 20 for constructing 580 ft. of 24-in. brick sewers, etc. Geo. T. Bouton, Clk. Bd. St. Comrs.

NEWARK, N. J.—Ernest Adam, Cy. Engr., has prepared plans for 66 to 30-in. brick sewers and 22 to 10-in. pipe sewers in the Forrest Hill district, estimated to cost $50,000 to $60,000.——It is proposed to construct sewers in about 10 streets in other portions of the city.

NORWOOD, PA.—At an election May 1 it was voted to issue $30,000 in bonds for constructing sewers and water-works.

PHILADELPHIA, PA.—Bids are asked until May 14 for building branch sewers. Thomas M. Thompson, Dir. Dept. Pub. Wks.

CINCINNATI, O.—Bids are asked by the board of administration until May 11 for constructing a sewer in Conroy St., between Sohn and Ravine Sts.

CLEVELAND, O.—Bids are asked until May 29 for constructing a sewer in Brooklyn St., between Clark Ave. and Sackett St. D. E. Wright, Dir. Pub. Wks.

EVANSTON, O.—Bids are asked until May 20 for constructing sewers in three streets. Address Chas. A. Ewing, Engr., Carlisle Bldg., Cincinnati; W. H. Knapp, Clk.

FINDLAY, O.—Bids are asked until May 31 for constructing about 5,000 ft. of 24 to 10-in. pipe sewers in six streets. S. P. De Wolfe, Cy. Clk.

MARTIN'S FERRY, O.—Specifications for a system have been prepared by E. J. Miller and adopted by the council.

DETROIT, MICH.—The board of public works has been directed to advertise for bids for rebuilding the Chene St. sewer for a distance of about 1,500 ft., estimated at $14,000.——The board of public works has rejected the bids recently received for constructing lateral sewers, and will readvertise the work.

LA SALLE, ILL.—C. H. Nicolet, Cy. Engr., writes us that the city contemplates building about 8,000 ft. of sewers this year, ranging in size from 28-in. brick to 8-in. pipe. Arrangements are not yet perfected for the work, and probably will not be for some weeks. The city did considerable work of this kind last year by day labor, and as this method proved satisfactory, the work may be done in the same way this year.

GALESVILLE, WIS.—The council has been petitioned to construct a system in the business district, and it is probable that a contract will be awarded as soon as plans have been prepared.

MILWAUKEE, WIS.—It is stated that Geo. H. Benzenberg, Cy. Engr., will soon advertise for bids for constructing a section of about 1,500 ft. of the west side sewer in Western and Cold Spring Aves., estimated to cost $40,000 to $45,000.

CRESTON, IA.—The question of improving the system is being considered.

DES MOINES, IA.—Bids are asked until May 18 for constructing 9,000 ft. of 18 and 12-in. pipe sewers. Edward Wright, Bd. Pub. Wks.

NEW ULM, MINN.—Plans are being prepared for a system, according to reports.

LOS ANGELES, CAL.—The committee has recommended the construction of sewers in several streets.

GARBAGE DISPOSAL.

BRIDGEPORT, CONN.—The Bridgeport Utilization Co., noted last week, was incorporated in New Jersey May 1 with a paid-up capital stock of $225,000; incorporators, Edward D. Hutchinson, 311 West 84th St., New York; John F. Dutton, 308 West 19th St., New York; James Foulke, 107 Monticello Ave., Jersey City.

HOBOKEN, N. J.—Bids are asked until May 22 for removing ashes, garbage, street sweepings, etc. M. C. McDermott, Cy. Clk.

NORWOOD, O.—An election will be held May 31 to vote on an issue of bonds, including $15,000 for a garbage crematory.

INDIANAPOLIS, IND.—The papers were signed last week annulling the city's contract with T. J. Jameson and J. S. Lazarus for the collection of garbage, the city paying $3,000. Propositions from several companies are being considered.

STREETS AND ROADS.

NEW HAVEN, CONN.—The legislature has been petitioned for authority to issue bonds for improving the streets.

BROOKLYN, N. Y.—Bids are asked until May 17 for repaving five streets with Belgian blocks and for paving and repaving portions of seven streets with cobblestones, and until May 21 for paving one street with cobblestones. A. T. White, Comr. Cy. Wks.

ELMIRA, N. Y.—Bids are asked until May 13 for furnishing 4,000 tons of broken stone. G. W. Nagle, Supt. Pub. Wks.

NEW YORK, N. Y.—Bids are asked by the commissioner of public works until May 16 for paving portions of two streets with asphalt on a concrete foundation.——The governor has signed the bill authorizing the city to spend $1,000,000 each year for three years for street improvements.

NIAGARA FALLS, N. Y.—The council has voted to pave a portion of Main St. with asphalt, estimated to cost $5,212. S. F. Arkush, Cy. Clk.

OYSTER BAY, N. Y.—Press reports state as follows: Walter Powell, Frederick Willetts, S. V. W. Fleet, Townsend Decck and P. Halstead Scudder, the committee appointed to formulate a plan of road improvement for the town of Oyster Bay, have called hearings to be held at different places, as follows: Oyster Bay, May 11; at Hicksville, May 15; at Farmingdale, May 22. The committee classifies the highways in the town into three classes. The main roads, over which the products are taken to market, are in the first class; the second class comprises the feeders of the first, or commercial roads, which connect the centers of activity in the town; while all other roads are put in the third class. The committee advocates three distinct grades of road building for these three grades of roads, varying in width and depth of macadam, according to the amount of travel and hauling done over each.

HOBOKEN, N. J.—Bids are asked until May 22 for paving and curbing Church Square Park. M. V. McDermott, Cy. Clk.

JERSEY CITY, N. J.—Bids are asked until May 13 for 12,500 sq. yds. of Belgian block paving, and 6,400 sq. yds. of asphalt paving on concrete foundation. Geo. T. Bouton, Clk. Bd. St. Comrs.——P. F. Wanser, Mayor, has recommended the construction of 5¼ miles of asphalt paved roads.

NEWARK, N. J.—The Roseville Improvement Association has prepared a report for the paving of Roseville Ave. and North Seventh St. with granite blocks. The committee consists of J. F. Anderson, W. B. Glasby, E. V. B. Dodd and Geo. H. Mason.

ERIE, PA.—Owing to a failure to secure a quorum May 6 the opening of bids for paving five streets was postponed until May 30.

PHILADELPHIA, PA.—An ordinance has been introduced in the council authorizing an issue of $1,200,000 in bonds for improving the pavements, for main sewers and for buildings. G. W. Kochersperger, Clk. Council.

READING, PA.—Press reports state that two new plans have been proposed for the inauguration of street paving in this city and ordinances have been introduced to carry both into effect. One is to set aside annually the total amount of the money coming to the city under the Brooks high license law for permanent street improvement, and the other is to take the surplus of the water department for this purpose. If either of these plans can be carried through the principal streets in the center of the city will be paved with asphalt or vitrified brick during the present year.

WILKINSBURG, PA.—Bids are asked until May 18 for 34,300 sq. yds. of brick paving, as stated in our advertising columns. Edeburn & Cooper, Engrs., Wilkinsburg, and 411 Grant St., Pittsburg.

BALTIMORE, MD.—Bids are asked until May 15 for repaving a portion of Broadway with sheet asphalt, and until May 20 for paving portions of three streets. A. E. Smyrk, Cy. Comr.

WASHINGTON, D. C.—Bids are asked until May 24 for 2,200 sq. yds. of asphalt paving and 500 sq. yds. of coal tar paving. Col. John M. Wilson, U. S. Engr., Public Bldgs. and Grounds.

ATHENS, GA.—The council is considering the question of paving Clayton St., and it is reported that surveys and estimates will soon be made for the work.

MONTGOMERY, ALA.—The following bids were received April 29 for paving North Court St. with Belgian blocks: Howard Neeley, $27,370; J. Bradley, $27,028; Venable Bros., Atlanta, Ga., $27,015 (awarded contract); J. B. Riley, $27,370; J. N. Hazelhurst, $27,698. An ordinance has been introduced authorizing the advertising for bids for paving portions of four streets.

LOUISVILLE, KY.—Bids are asked by the board of public works until May 17 for 27 contracts for paving and repaving with brick, granite blocks and asphalt. J. H. Hoertz, Secy.

CINCINNATI, O.—Bids are asked by the board of administration until May 17 for paving portions of five streets with brick.

CLEVELAND, O.—Bids are asked until May 11 for paving the approaches to the Columbus St. bridge with Medina sandstone. D. E. Wright, Dir. Pub. Wks.

ELYRIA, O.—Bids are asked until May 24 for paving Middle Ave. J. F. Allen, Clk.

EVANSTON, O.—Bids are asked until May 27 for improving portions of three streets. Address Chas. A. Ewing, Engr., Carlisle Building, Cincinnati.

WARREN, O.—Bids are asked until May 21 for 6,480 sq. yds. of brick paving. A. E. Andrews, Cy. Clk.

HAGERSTOWN, IND.—We are informed that this place will build 1½ miles of cement sidewalks.

INDIANAPOLIS, IND.—Bids are asked until May 16 for 748 sq. yds. asphalt paving. Chas. C. Brown, Cy. Engr.——Resolutions have been passed for asphalt crossings at the state ditch on four streets, contracts for which will be awarded about June 10.——About 5,400 ft. cement walks have been ordered on four streets.

KOKOMO, IND.—The council has voted to pave four streets with brick, and to build cement sidewalks.

SAULT STE. MARIE, MICH.—The proposition to issue $100,000 in bonds for improving the roads of Chippewa county has been carried.

CANTON, ILL.—Bids are asked until May 21 for 27,000 sq. yds. of paving, with two courses of small brick upon 5 ins. of sand, as stated in our advertising columns. G. W. Chandler, Cy. Engr.; Eugene Whiting, Cy. Clk.

LA SALLE, ILL.—The question of paving is being considered, and it is probable that several blocks will be paved with brick. C. H. Nicolet, Cy. Engr.

MILWAUKEE, WIS.—The Grand Ave. Improvement Association has decided to have that avenue paved from 13th St. to 21st St. with asphalt, and it is proposed next year to pave it to Western Ave. Pres., C. M. Cottrill.

GALVESTON, TEX.—The legislature has been petitioned to grant authority to the city to issue $40,000 in bonds for improving the streets.

LOS ANGELES, CAL.—The board of public works has been petitioned to pave Main St. with asphalt.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

STEAM ROAD ROLLER.—Easton, Pa.—Bids are asked until May 16 for a steam road roller. H. R. Fehr, Cy. Engr.

DREDGING.—Portland, Me.—Bids are asked until May 16 for dredging in Harrisseckit River, Me., as stated in our advertising columns. Maj. D. P. Heap, U. S. Engr. Office.

SUBWAY.—New York, N. Y.—The board of electrical control has given the Metropolitan Telegraph & Telephone Co. permission to build a subway in Fifth Ave., from 12th to 23d St.

METAL WORK.—Tompkinsville, N. Y.—Bids are asked until May 23 for the metal work for the South Face wharf at the lighthouse. Lieut.-Col. Peter C. Hains, U. S. Lighthouse Engr.

RIGHT TO CUT TIMBER.—Toronto, Ont.—Bids are asked until June 4 for the right to cut the pine trees in the township of Vankoughnet, in the district of Algoma. A. S. Hardy, Comr. of Crown Lands.

STREET SPRINKLING, SWEEPING, ETC.—Buffalo, N. Y.—Bids are asked until May 11 for sprinkling, sweeping and cleaning improved streets for three years. R. G. Parsons, Secy. Dept. Pub. Wks.

AQUARIUM.—Atlanta, Ga.—Bids are asked until May 15 for the construction of an aquarium at the exposition grounds. Address Dr. T. H. Bean, U. S. Commission of Fish and Fisheries, Washington, D. C.

WHARF.—Boston, Mass.—The New York & New England R. R. Co. is reported about to build a $150,000 wharf at South Boston. An official is quoted as stating that the contracts will probably be awarded this week.

PIERS, ETC.—Detroit, Mich.—Bids are asked until June 7 for removing material from movable dam and 800 ft. lock approaches, and for the construction of piers for lock approaches, as stated in our advertising columns. Col. O. M. Poe, U. S. Engr. Office.

DITCH.—Monticello, Ind.—Bids are asked until May 15 for the construction of the Big Creek ditch in Big Creek and West Point townships, White county. The work will consist principally of dredging; total length, about 25 miles; estimated cost, about $25,000. Web P. Bushnell, Engr.

CONVEYOR, ETC.—New York, N. Y.—Bids are asked by the commissioner of public works until May 15 for constructing and erecting a conveyor, with the necessary tunnel, tower, housing, pier, engines, scales and appurtenances, to convey coal from boat in Harlem River to and store same in coalhouse of the new high service works.

DOCK.—West Superior, Wis.—A press report states that the Chicago, St. Paul & Omaha Ry. Co. has awarded a contract to Winston Bros. for a large section of a merchandise dock, which it has decided to build on Allouez Bay. Work will begin at once. Williams, Dougherty & Upham have the contract for dredging the slip and connecting the canal. This contract was made May 3. The dock will be 3,000 ft. long and about 200 ft. wide. About $100,000 will be expended this year on its construction.

WATER FRONT IMPROVEMENTS.—Tacoma, Wash.—A press report states as follows: The Northern Pacific R. R. Co. has begun work on improvements on the water front that will cost $300,000. Local companies will make improvements costing $200,000 more. The railway will build a solid rock and stone seawall along its water front property. It will build four freight warehouses, each 40 × 400 ft., and coal bunkers of 10,000 tons storage capacity, capable of handling 5,000 tons per 10 hours. The Cascade Oatmeal Co. is preparing to erect a 500-bbl. flour mill for the Oriental trade.

CONTRACT PRICES.

DREDGING.—Wilmington, Del.—The following bids were opened at the U. S. Engineer Office, April 29, for dredging in Appoquinimink, St. George's, Smyrna, Murderkill and Mispillion rivers: Frank C. Somers, of Camden, N. J., 14½ cts. per cu. yd., place measurement; Fred L. Somers, of Philadelphia, 12.7 cts.; American Dredging Co., of Philadelphia, 19.3 cts.; Atlas Dredging Co., 19½ cts.

PIPE, VALVES, ETC.—Minneapolis, Minn.—F. W. Cappelen, Cy. Engr., informs us that the following bids were received April 30: For 870.56 tons of 12, 36 and 42-in. pipe (mostly 42-in.), Dennis Long & Co., $23.50 per ton; Howard Harrison Iron Co., $23.75; Addyston Pipe & Steel Co., $24 (all were rejected); for 88 tons of specials, Twin City Iron Works, of Minneapolis, $54 per ton (accepted); Northwestern Wheel & Foundry Co., St. Paul, $70; Union Iron Works, Minneapolis, $74.90; for valves (contract awarded to the Eddy Valve Co.):

	Eddy Valve Co.	Rensselaer V. Co.	Mich. Brass & Iron Wks.
12-in.	$25 to $74	$65	$50
36-in.	280 " 482	375	470
42-in.	546 " 682	480	$600 to 700
48-in.	746 " 930	900	800 " 900

RESERVOIR.—Minneapolis, Minn.—The council has rejected all the bids for a distributing reservoir, and has directed that the work be done by day labor, under the direction of F. W. Cappelen, Cy. Engr. The bids were as follows:

Bids Received at Minneapolis, Minn., April 30, for Constructing a Reservoir.

Quantities.		City Engineer's estimate.	Winston Bros.	Halvorsen, Richardson & Co.	Barnett & Record Co.	John Woods & Co.	Rinker & Hoff.	Foley, Guthrie & Grant.
Earth excavation, Main Boulevard	26,000 cu. yds.	$0.20	$0.16	$0.14½	$0.15	$0.17	$0.16	$0.18
" " on reservoir site	264,000 " "	.38	.25	.21½	.24	.41	.24	.38
Peat " " " "	80,000 " "	.15	.15	.12½	.18	.40	.18	.17
Puddle (preparing and placing)	35,000 " "	.45	.30	.25	.45	.60	.30	.35
Wooden culvert	56 ft.	1.00	1.00	.50	1.10	1.50	.85	1.00
24-in. vitrified clay pipe	120 "	1.75	1.20	1.25	1.50	1.25	1.60	1.75
Macadam on Main Boulevard	14,070 sq. yds.	.70	.60	.57½	.75	.60	.75	.75
" on reservoir boulevard	13,500 " "	.65	.55	.55	.70	.60	.65	.73
Sodding on reservoir site	16,400 " "	.12½	.12	.08½	.16	.30	.10	.14
Cobblestone gutters	1,267 " "	.30	.30	.20	.25	.50	.30	.60
Broken rock lining	17,300 cu. "	2.00	1.85	1.00	1.75	2.25	1.90	1.90
Inlet tower, complete	1	3,200.00	2,000.00	2,750.00	3,800.00	2,000.00	3,175.00	3,000.00
Outlet towers, complete	2	6,400.00	4,000.00	5,500.00	7,600.00	4,000.00	6,350.00	6,200.00
Round gate well, complete	1	650.00	600.00	525.00	550.00	500.00	520.00	625.00
Oval gate well, complete	1	650.00	600.00	525.00	570.00	500.00	520.00	625.00
Concrete around pipes, etc.	1,100 cu. yds.	4,675.00	4,675.00	3,135.00	4,840.00	6,050.00	4,950.00	4,400.00
Laying pipes and specials, setting gates, trenches, etc.		9,530.00	9,000.00	9,500.00	9,640.00	6,500.00	6,500.00	9,000.00
Totals		$214,295	$163,955	$149,736	$177,870	$246,464	$168,892	$211,300

SEWERS.—Manchester, Va.—Edwin Mitchell, Engr., has sent us a statement of the bids received April 25 for constructing a system of sewers, as advertised in Engineering News. Separate bids were received for furnishing the materials, for the work alone, and for construction, including all materials. The total bids received for furnishing sewer pipe were as follows: Warner, Moore & Co., Richmond, Va., $10,938; Zach T. Darrow, Marietta, O., $12,465; Lookout Sewer Pipe Co., Chattanooga, Tenn., $10,970; Montague & Co., Chattanooga, Tenn., $11,878. The bids show that the city can save nothing by purchasing the materials, and it is probable that the contract for the work complete will be awarded to one party. The bids for constructing the sewers, including the furnishing of all materials, were as follows:

Bids Received at Manchester, Va., April 25, 1895, for Constructing Sewers.

Quantities.		Z. T. Darrow, Marietta, O.	Anderson, Ferriter & Perkins, Richmond, Va.	Hankins, Mosby & Co., Richmond, Va.	Lane, Bros. & Scottsville, Va.	J. T. Pritchy, Lancaster, Pa.	A. C. Maynard & Co., Richmond, Va.	Vaughan & Luck, Charlottesville, Va.	P. H. Harrison & Sons, Newark, N. J.	Wright, Carpenter & Co., Richmond, Va.	Watkins & Hardaway, Birmingham, Ala.	Jas. C. Danforth, Bay City, Mich.	Coats & Sullivan, Columbus, O.	S. P. Clay, Richmond, Va.	Robertson & Myers, Richmond, Va.	Curtis M. Braxton, Newport News, Va.	B. J. Corle, Washington, D. C.	Gooch, Rinehart & Dennis, Richmond, Va.	H. P. Beck, Richmond, Va.	Fred Rolin, Manchester, Va.
24-in. T. C. pipe	1,700 ft.	$2.50	$0.95	$1.50	$1.12	$1.30	$1.20	$1.40	$1.40	$1.57	$1.09	$1.15	$1.45	$1.05	$1.14	$1.30	$1.75	$1.30	$1.64	$1.2162
18-in. " " "	1,465 "	.60	.58	.90	.72	.72	.7845	.75	.75	.81	.6925	.67	.77	.66	.86	.90	1.20	1.00	.93	.8996
15-in. " " "	1,570 "	.42	.45	.60	.54	.53	.5225	.60	.60	.63	.5725	.58	.60	.56	.71	.70	.90	.65	.72	.8405
12-in. " " "	2,860 "	.29	.40	.40	.39	.47	.4460	.45	.50	.53	.4075	.49	.48	.46	.59	.60	.75	.55	.61	.7307
10-in. " " "	5,035 "	.25	.33	.35	.35	.45	.4235	.40	.45	.43	.3775	.44	.42	.41	.47	.48	.60	.50	.55	.6589
8-in. " " "	9,940 "	.18	.28	.26	.28	.34	.3120	.33	.34	.35	.32	.35	.33	.36	.40	.40	.45	.40	.50	.5695
6-in. " " "	71,550 "	.15	.24	.2250	.25	.25	.2655	.27	.27	.2750	.28	.31	.30	.31	.30	.32	.32	.35	.45	.5252
4-in. " " "	10,000 "	.09	.20	.20	.19	.1850	.2375	.20	.20	.22	.1850	.22	.25	.27	.26	.21	.25	.32	.43	.4712
6-in. iron pipe	72 "	1.00	.50	1.00	.50	.50	.8350	.55	.60	.80	.75	1.00	1.00	.75	.60	2.50	1.20	1.40	1.30	1.0577
24-in. iron pipe undr Ry	48 "	5.00	2.00	3.20	3.00	3.50	2.74	3.25	4.00	5.00	4.50	4.00	6.00	3.00	3.60	8.00	6.00	4.00	5.19	3.3925
24-in. " " outlet	48 "	5.00	2.00	2.70	3.00	3.25	2.74	6.75	3.00	5.00	4.50	4.00	6.00	3.00	3.00	21.00	4.20	4.00	2.69	3.44
1½-in. tile drain	10,000 "	.04	.08	.02	.04	.04	.0570	.06	.0025	.03	.0375	.08	.05	.05	.0250	.03	.04	.08	.05	.04
Flushtanks	87	35.00	21.40	27.50	35.00	30.00	23.50	25.00	31.00	21.00	33.00	24.00	28.00	30.00	25.00	60.00	40.00	40.00	30.00	33.00
Lampholes	52	5.00	5.00	5.00	7.00	6.00	8.50	5.00	5.00	4.00	7.00	7.00	6.00	6.00	8.00	14.00	12.00	12.00	4.40	5.64
Manholes	128	25.00	19.40	26.50	27.50	20.00	23.50	20.00	25.00	21.00	31.50	24.00	24.00	23.00	25.00	30.00	35.00	40.00	28.00	31.20
Piling at outlet		150.00	200.00	75.00	100.00	75.00	103.00	400.00	50.00	300.00	100.00	45.00	128.00	400.00	115.00	250.00	118.20	125.00	200.00	227.00
Totals		$28,905	$33,323	$35,075	$37,008	$37,909	$38,278	$38,835	$39,426	$39,741	$40,255	$41,948	$42,364	$42,578	$42,952	$49,642	$50,859	$51,138	$58,857	$66,236

CAST IRON PIPE.—Quincy, Mass.—A contract for 900 tons of cast iron pipe has been awarded at $21.16 per gross ton.

SEWERS.—Brooklyn, N. Y.—Frank Lyman, Deputy Comr. Cy. Wks., informs us that the following bids were received May 6 for constructing section 2 of the Greene Ave. relief sewer, as advertised in Engineering News of May 2:

Quantities.		L. R. Clapp.	D. J. Creem.	Harrison & Sons.	J. McNamee.	Crawford & Co.
Brick sewer:						
120-in., 2,600 ft., at		$27.00	$27.00	$20.00	$28.50	$31.25
90-in., 2,190 " "		20.00	17.00	19.00	20.00	21.50
78-in., 2,690 " "		16.00	13.00	16.00	18.00	17.50
54-in., 2,600 " "		6.50	5.00	6.45	5.40	7.50
48-in., 1,100 " "		5.00	4.25	6.50	5.00	6.75
36-in., 500 " "		4.25	3.50	3.80	4.25	4.75
30-in., 780 " "		3.25	3.00	3.25	3.40	4.25
Cement pipe sewer:						
15-in., 240 ft., at		1.10	1.00	.90	1.30	1.45
12-in., 4,500 " "		1.10	.75	.70	1.00	1.35
Vitrified pipe sewer:						
15-in., 240 ft., at		.80	1.40	.95	1.40	.95
12-in., 4,500 " "		.80	1.00	.70	1.15	.85
Drain pipe:						
12-in. 2,600 " "		.20	.15	.30	.30	.50
Manholes	3	100.00	100.00	100.00	150.00	100.00
"	100	35.00	29.00	32.00	32.00	34.00
Street basins	9	110.00	95.00	90.00	110.00	100.00
Concrete 100 cu. yds.		5.00	4.00	4.00	5.00	4.75
Planking, 850 M. ft.		16.00	18.00	16.00	20.00	20.00

The total bids were as follows:

	With vitrified pipe.	With cement pipe.
L. R. Clapp	$207,302	$208,724
D. J. Creem	189,146	187,925
P. H. Harrison & Sons	210,873	210,861
John McNamee	219,728	219,029
Crawford & Co.	235,453	237,823

SEWERS.—Indianapolis, Ind.—The following contracts were awarded May 4: Local sewer in Alabama and Sinker Sts., to Gansberg & Roney, at $1.30 a lin. ft. Conduitt-De Ruiter Co. bid $1.43. The sewer is 1,496 ft. long, consisting of 300 ft. of 18 × 27-in. brick sewer, 936 ft. of 12-in., 260 ft. of 18-in. pipe, 536 ft. of 6-in. house connections, four catchbasins, seven manholes. Sewer in alley north of Coburn St., Gansberg & Roney, 76 cts. Other bids were at 80, 85, 93 cts. and $1. The work is 1,140 ft. of 15-in. pipe, 525 ft. of 10-in. pipe, 616 ft. of 6-in. house connections, six manholes, one lamphole, one flushtank. Local contract being divided between the Carnegie Steel Co., Pennsylvania Steel Co. and the Cambria Iron Co.

BRICK PAVING.—Peoria, Ill.—A. D. Thompson, Asst. Engr., writes us that the contracts for paving several streets with one course of small brick on 6 ins. of broken stone concrete foundation, for which bids were opened May 1, have been awarded to Jas. S. Allen, of Peoria, the lowest bidder on all the work, at the following prices:

	Paving, per. sq. yd.	Excavation, per cu. yd.	Curb setting, per lin. ft	Total.
Fourth Ave.	$1.24¾	$0.19	$0.05¼	$9,915
Missouri Ave.	1.27	0.20	0.05½	6,891
Park Place	1.24¾	0.19	0.05¼	2,081
East Park Pl.	1.24¾	0.19	0.05¼	2,055
West Park Pl.	1.24¾	0.19	0.05¼	2,002

DREDGING.—Detroit, Mich.—The following bids were received by Lieut.-Col. G. J. Lydecker, U. S. Engr. Office, May 2, for dredging (1) Cheboygan Harbor, (2) Saginaw River, above Bay City, and (3) bar at mouth of Saginaw River, Mich., as advertised in Engineering News, the price being per cubic yard:

Bidder.	1.	2.	3.
C. H. Hubbell, E. Tawas, Mich.		$0.45	$0.35
Hungston & Woods, Buffalo	$.24	.39	.44
Carkin, Stickney & Cram, East Saginaw, Mich.	.35	.34	.33
Chris. H. Starke, Milwaukee	.14	...	.35
Racine Dredge Co, Racine, Wis.	...	..	41
C. E. Mitchell & Co., Ludington.	.12 9-10	...	...
Bay City D'dg'g Co., Bay City	...	.33⅓	.50
Edmund Hall, Detroit	...	...	.23

ASPHALT PAVING.—Indianapolis, Ind.—Bids were opened May 4 for asphalting West St., 1,330 ft. long and 40 ft. wide. The Warren-Scharf Asphalt Paving Co. bid $8.10 per lin. ft. of each side of the street, for stratified limestone curb or combined curb and gutter, using Trinidad Lake asphalt. The Western Paving & Supply Co. bid $6.82 for the same, the Indiana Bermudez Asphalt Co. bid $6.98 on Bermudez asphalt, the Fruin-Bambrick Construction Co., of St. Louis, bid $5.14 on Berea curb, $5.24 on stratified limestone and $5.44 on combined curb and gutter, to use "Trinidad Pitch Lake asphalt, equal to that mined directly from the Pitch Lake," and the Trinidad Asphalt Refining Co. bid $5.14 on "Land or overflow" asphalt. The work to be done is 6,350 sq. yds. of asphalt on Portland cement concrete, 2,686 ft. of straight curb, 212 ft. of granite round corners, 220 ft. of marginal stone, 1 catch basin, 11 inlets, 165 ft. of 15-in. pipe drain. Bids were also opened for asphalting Prospect St., 2,612 ft. long and 25.5 ft. wide. With same materials as above, the bids were: Warren-Scharf, $6.18 per lin. ft. of each side; Western Paving & Supply Co., $4.84; Indiana Bermudez Co., $5.02; Fruin-Bambrick Co., $4.29, $4.39, $4.59; Trinidad Asphalt Refining Co., $3.64. The work to be done includes 7,808 sq. yds. of asphalt on 6 ins. of Portland cement concrete, 4,843 ft. straight curb, 264 ft. granite round corners, 383 ft. of marginal stone,

SEWERS.—Richmond, Ind.—The contracts for constructing the Linden Hill trunk sewer and sub-trunk sewer have been awarded to Daniel Foley, at $11,478 for the trunk sewer and $2,400 for the sub-trunk sewer. The work includes 2,378 ft. of egg-shaped brick sewer, 3 ft. × 3 ft. 8⅝ ins. and 2 ft. 7 ins. × 3 ft. 2¼ ins., and 3,672 ft. of 24 to 9-in. pipe sewer, the cut ranging from 7 to 20 ft. The bids for the trunk sewer were as follows:

Bids Received at Richmond, Ind., May 3, for Constructing a Trunk Sewer.

Items.		Cronin & Son, Richmond, Ind.	Wm. Rehling, Richmond, Ind.	Ulrick, Nissley & Williams, Springfield, O.	Campfield & Goodrich, Richmond, Ind.	Wm. Wagner, Richmond, Ind.	Campbell & Dennis, Joliet, Ill.	D. Foley, Indianapolis, Ind.	Berry & Day, Bellaire, O.
Brick masonry	per cu. yd.	$6.50	$6.50	$7.35	$5.55	$9.40	$7.00	$5.95	$12.00
Concrete masonry	" " "	5.00	5.50	6.00	6.00	3.50	3.00	4.00	3.00
Excavation	" " "	.75	.70	.50	.50	1.25	.30	.32	.50
Lumber left in trench	" M. ft.	22.00	14.00	30.00	15.00	13.00	25.00	25.00	20.00
Cast iron	" lb.	.03	.03	.02	.02½	.03	.02	.03	.03
Manholes	each	25.00	40.00	50.00	30.00	30.00	25.00	25.00	35.00
Lampholes	"	20.00	15.00	10.00	15.00	7.50	5.00	7.00	10.00
Flushtanks	"	85.00	85.00	60.00	60.00	100.00	50.00	35.00	45.00
Catchbasins	"	30.00	40.00	25.00	35.00	13.75	20.00	22.00	25.00
Sewer inlets	"	18.00	15.00	25.00	3.00	12.65	10.00	7.00	15.00
Sewer pipe, discount from list price		.65	.70	.60	.78[1]	.75	.75[2]	.75	.65
5 x 20-in. curbing	per lin. ft.	.85	...	.50	.50	....	.60	.40	.50
Paving	" square.	4.00	4.00	3.50	5.00	....	.40	1.00	.50
Feed pipe, incldg stop box and cons.	" ft.	.35	.40	.50	.10	....	.20	.15	.45
Price, complete	" lin. ft.	4.75	3.95	3.95	3.37	7.51	3.00	2.79	3.06
Totals		$19,712	$16,392	$16,392	$13,975	$30,166	$12,450	$11,478	$12,620

[1] And 67½ cts. [2] And 68 cts.

STREET CLEANING.—Indianapolis, Ind.—Bids for cleaning certain new streets were received May 4 from J. R. Kennington at 75 cts., Fuehring Bros. at 39 to 56 cts. and the Indianapolis Street Cleaning Co. at 23½ to 32 cts. per 10,000 sq. ft. for the season. The latter was awarded the contract.

STEEL RAILS.—Philadelphia, Pa.—The Pennsylvania R. R. Co. is reported to have awarded a contract for 20,000 tons of steel rails, at $22 per ton. the 3 manholes, 3 catchbasins, 3 inlets, 45 ft. 18-in. pipe, 35 ft. 20-in., 1,390 ft. 24-in., 6 cu. yds. of masonry. The board of public works heard the arguments of the land asphalt companies on Saturday afternoon, and of the Western Paving & Supply Co., the lowest bidders on Pitch Lake asphalt, but has not yet rendered its decision. The Fruin-Bambrick Co. was represented by its president, general manager, attorney, superintendent and Prof. F. A. Peckham.

CAST IRON PIPE.—Auburn, Me.—The following bids were received by the water commissioners, April 25, for about $2,000 worth of cast iron pipe:

	Pipe, per gross ton.	Specials, per lb.
Anniston Pipe & Foundry Co.	$20.45	$.02
R. D. Wood & Co.	22.50	.02½
John Fox	23.15	.021
Radford Pipe & Foundry Co.	23.60	.02½
Fred A. Houdiette & Son	21.90	.022
National Foundry & Pipe Works	23.35	...
Donaldson Iron Co.	22.70	.02⅞
Reading Foundry Co.	22.62	.02¾
McNeal Foundry & Pipe Co.	23.91	.62⅜

METAL MARKET PRICES.

LEAD.—New York: 3.07 to 3.1 cts. Chicago: 2.95 cts. St. Louis: 2.85 to 2.87 cts.

NAILS.—Pittsburg: 90 cts. for wire, and 80 cts. for cut at mill in carload lots.

BARBED WIRE.—Pittsburg: galvanized, $1.90; plain, $1.20 for carloads at mill.

FOUNDRY AND PIG IRON.—New York: $10.50 to $12.50. Pittsburg: $9.75 to $10.50. Chicago: $9.75 to $10.75.

TRACK MATERIAL.—New York: angle bars, 0.95 to 1.05 cts.; spikes, 1.35 to 1.4 cts.; track bolts, 1.75 to 1.9 cts. with square, and 1.9 to 2 cts. with hexagon nuts. Chicago: angle bars, 1.17 to 1.25 cts.; spikes, 1.6 to 1.7 cts.; track bolts, 1.9 to 2 cts., with hexagon nuts.

RAILS.—New York: $22 at eastern mills and $22.75 at tidewater; old rails, $12 for iron, and $10 to $10.50 for steel; steel rails fit for relaying, $14; light rails, $20 to $21; girder rails, $24. Pittsburg: $22 for standard sections of 45 lbs. and over; $23 for light sections; old rails, $12.50 for iron and $10 for steel. Chicago: $23 for standard sections; $25 for light sections; old rails, $11.50 to $12 for iron, and $7.50 to $9.50 for steel.

STRUCTURAL MATERIAL.—New York: beams, 1.3 to 1.5 cts.; channels, 1.35 to 1.5 cts.; angles, 1.2 to 1.35 cts.; tees, 1.4 to 1.6 cts.; universal mill plates, 1.3 to 1.35 cts.; steel plates, 1.2 to 1.3 cts. for tank, 1.35 to 1.45 cts. for shell, 1.5 to 1.65 cts. for gauge, 1.75 to 2 cts. for ordinary firebox, 2 to 2.5 cts. for locomotive firebox. Pittsburg: beams, 1.2 to 1.5 cts.; channels, 1.2 to 1.5 cts.; angles, 1.1 to 1.2 cts., tees, 1.25 to 1.3 cts.; universal mill plates, 1.1 to 1.2 cts.; steel plates, 1.15 to 1.2 cts. for tank, 1.2 to 1.25 cts. for shell, 1.25 to 1.3 cts. for flange, 1.75 to 2 cts. for ordinary firebox, and 2 to 4 cts. for locomotive firebox. Chicago: beams, 1.4 to 1.45 cts; channels, 1.4 to 1.45 cts.; angles, 1.3 to 1.35 cts.; tees, 1.55 to 1.6 cts.; universal plates, 1.3 to 1.35 cts.; steel plates, 1.3 cts. for tank, 1.55 to 2 cts. for flange, 2 to 4.5 cts. for firebox.

INDUSTRIAL NOTES.

RITER & CONLEY, of Pittsburg, Pa., have an order for a steel dredge boat 172 ft. long, 40 ft. beam and 5 ft. deep, for the Mississippi Dredge Co.

THE HOWARD-HARRISON IRON CO., of Bessemer, Ala., has a contract for 5,000 tons of 20 to 36-in. water pipe for the new water-works at Galveston, Tex.

THE COLORADO FUEL & IRON CO., of Pueblo, Colo., has the contract for steel rails for the completion of the extension of the Union Pacific, Denver & Gulf Ry.

THE PULLMAN PALACE CAR CO., of Chicago, Ill., has an order for 100 gondola coal cars of 60,000 lbs. capacity for the Columbus, Hocking Valley & Toledo R. R.

THE GENERAL COMPRESSED AIR CO., of Rome, N. Y., will manufacture the Hardie compressed air motors for street cars in the shops of the Rome Locomotive Works.

THE INTERNATIONAL STEEL POST CO., of St. Louis, Mo., has a contract for fencing the St. Louis Fair Association racecourse with its steel posts and ten lines of No. 8 galvanized wire.

THE WISCONSIN BRIDGE & IRON WORKS, of Milwaukee, Wis., has contracts for a highway bridge at West Superior, Wis., and a viaduct for the Wisconsin Central R. R. at Abbotsford, Wis.

JAMES J. PEARSON, of the Capo-Farad Battery & Appliance Works, New York, N. Y., announces that as the demand for the Capo-Farad battery has outgrown the existing facilities of supply, he has decided to extend the manufacture, and has therefore established the above works.

THE UNION BRICK WORKS, of Tacoma, Wash., has the contract for 2,200,000 brick for completing the lining of the Stampede tunnel on the Northern Pacific R. R. This will make 12,000,000 brick supplied by the works for this tunnel. This work was described in our issue of Oct. 10, 1891.

THE N. & G. TAYLOR CO., of Philadelphia, Pa., manufacturing tinplate, announces that it has given up its quarters in Water St., New York city, and has moved to new offices in the Cable Building, 621 Broadway, in charge of Mr. George Livingston. The firm also announces that it has secured larger and better warehouse facilities for the quick filling of orders.

THE SMITH & WINCHESTER CO., of Boston, Mass., manufacturing steam, gas and water supplies, informs us that it has opened an office at 141 Center St., New York city, and proposes to carry a full line of samples of its Winchester boiler and other specialties. It has also engaged the services of J. W. Fryer, expert heater engineer, to take charge of the office.

THE PITTSBURG LOCOMOTIVE WORKS, of Pittsburg, Pa., is building a new power house and making other improvements to its plant. It has an order for 12 ten-wheel engines, with cylinders 18 × 24 ins., and weighing 112,000 lbs., with 90,000 lbs. on the driving wheels, for the Georgetown & Trinity R. R., and another for a consolidation engine, with cylinders 22 × 28 ins., for the Duluth, Missabe & Northern R. R.

MUNSON BROS., of Utica, N. Y., has placed contracts for the erection of new shops to replace those burned last winter. There will be a foundry 80 × 100 ft., one story high, and a pattern shop and store-house 40 × 82 ft., with wings 43 × 66 ft., all three stories high. The buildings will be of brick, with floors of slow-burning mill construction, iron roof trusses and slate roofs, and will be fitted with automatic sprinklers.

THE YOUNGSTOWN BRIDGE CO., of Youngstown, O., has received the contract for the Broadway bridge in Denver, Colo.; the full width of the street is 100 ft., and the girders will be 125 ft. long. It has also been awarded contracts for four spans on the Texas & Pacific Ry., the boiler house for the American Tin Plate Co., Ellwood, Ind.; the steel building, girders and columns for the smelter works at Anaconda, Mont.; and a heavy girder span for Indianapolis, Ind.

C. W. HOOPER, of Dubuque, Ia., is organizing a new company, with a capital of $300,000, for manufacturing drawn and stamped steel work, and enameling steel and iron. A large press is now being manufactured in Europe which will form vessels 2 ft. deep and 8 ft. diameter, and will be used for making tanks, baths, hoppers, barrels, chemical pans, etc. Mr. Hooper is connected with the enameling firm of Charles Hooper & Co., of Dubuque, Ia.

THE BERLIN IRON BRIDGE CO., of East Berlin, Conn., is erecting the new crematory building at the Brooklyn navy yard, and has designed and built the new machine shop for the Goulds Mfg. Co., of Seneca Falls, N. Y.; this latter building will have a steel frame, and will be equipped with a 15-ton traveling crane. It is also building an iron bridge at Thomaston, Conn., consisting of two plate girder spans, each 60 ft. long, with a roadway 22 ft. wide, and two sidewalks, each 6 ft. wide. The bridge will be entirely of iron and concrete, no woodwork being used in the construction.

THE PENN BRIDGE CO., of Beaver Falls, Pa., reports its works running full and with the following contracts: Boiler house for Crescent Mfg. Co., at Muskegon, Mich.; ladle house and mixer house for the new process steel plant of the Cambria Iron Co., Johnstown, Pa.; annealing house for George W. Johnson's sheet mill at New Castle, Pa., 120 × 80 ft., with additions 95 × 25 ft.; roof trusses for car barn and power house of Clearfield Traction Co., at Phillipsburg, Pa., buildings 50 × 380 ft. It reports also that work is progressing on the bridge across the Youghiogheny at McKeesport, Pa., and that it has contracts for five spans of bridges 60 to 75 ft. long, in Hill County, Texas; one drawbridge of 165 ft. span for the city of New Orleans; one span of 120 ft. for Hamburg, N. Y., and one span 100 ft. for Shelby County, Ala.

THE AMERICAN SIGNAL CO., of Baltimore, Md., manufacturing the road crossing signal illustrated in our issue of June 28, 1894, calls attention to some improvements being made at its works at Thurmont, Md., which have been necessitated by an increase in business. It is now erecting a new building fronting 40 ft. on Boundary Ave., and adjoining the old one, it being set back about 10 ft. from the building line of the old building, making the two form an L. The lower part of this building will contain the blacksmiths' forges and three brass furnaces, with ample room for brass and gong work. The second floor will be equipped with modern machinery for the manufacture of the road crossing signal, which is said to be giving entire satisfaction. The company also contemplates the erection of another building similar to the one now being built, which will be 40 × 80 ft., and will contain a new and modern iron cupola. Orders for all supplies for the first building have been placed. It is not likely the second one will be erected before the fall. The company has recently completed contracts with the Southern Pacific Co.; New York, Lake Erie & Western R. R.; Richmond, Fredericksburg & Potomac R. R., and the Michigan Central R. R., and is now completing work for the Philadelphia & Erie and Detroit, Lansing & Northern railways.

THE WESTINGHOUSE MACHINE CO., of Pittsburg, Pa., reports that contracts have been let and ground broken for its new shops at East Pittsburg. The main building will be 602 × 230 ft., of fireproof construction, being a steel structure, with brick walls, slate roofs and wire-glass skylights. A building of similar construction, 200 × 60 ft., will contain the hammer shop and power plant. Within the main building, through which switches are run direct from the main line of the Pennsylvania R. R., will be the machine shop, erecting shop, foundry, pattern shop, warehouse, offices, etc. Two crane runways, each 60 ft. span, on which electric cranes will be used, extend the length of the building. The remaining space is taken up with galleries, provided with lighter crane service. The present equipment of machine tools will be increased by the addition of whatever is best to facilitate the manufacture and handling of the company's product. The hammer shop will have every convenience that the best shop practice can suggest, and will be equipped with one 8-ton, one 3-ton, one 2-ton and several smaller hammers, besides the usual cranes. The list of contractors for the work, which will cost $400,000, exclusive of machinery, is given in our column of "Buildings." A few years ago the Westinghouse Air Brake Co. erected large shops at Wilmerding, a new town on the Pennsylvania R. R., about 12 miles from Pittsburg. The location at East Pittsburg of the Westinghouse Electric & Mfg. Co.'s immense plant, and the Fuel Gas & Mfg. Co.'s factory, to be followed by the removal of the Westinghouse Machine Co. to the same place, will form, with the Union Switch & Signal Co.'s works at Swissvale, a concentration of Westinghouse interests, practically at one point, within a half-hour's ride of the city.

NEW COMPANIES.—California Tule Anti-Caloric Co., San Francisco, Cal.; $100,000, with $250 paid in; cold storage and refrigerating plant; Kirkham Wright and Julius Sonntag, of San Francisco; and James C. Bell, of Sausalito.

Little Rock Fence & Wire Co., Little Rock, Ark.; $10,000; Supt., H. A. Sparling.

Packless Valve Co., Springfield, Ill.; $5,000; William J. Conkling and John N. Murphy.

Logansport & Wabash Valley Gas Co., Wabash, Ind.; $1,750,000; natural gas; J. Dietrich.

American Wood Preserving Co., Chicago, Ill.; $2,000; Henry W. Welhe and Mary E. Bird.

Fredonia Gas Co., Fredonia, Kan.; $10,000; C. H. Pierce, J. W. Pauler and F. E. Lister.

Hampson Stone Co., Chicago, Ill.; $2,000; Lot Hampson, Thomas Kelly and F. C. Hampson.

Marysville Plaster Cement Co., of Marysville, Kan.; $25,000; W. H. Smith and P. E. Simmons.

United Motor Co., Cleveland, O.; $10,000; H. H. McKeehan, A. C. Dustin and H. A. Kelley.

Casparis Stone Co., Columbus, O.; $100,000; S. Casparis, Thomas S. Brooks and O. H. Schenck.

Kiddoo Milling Co., Oswego, Kan.; $50,000; to build an elevator; E. C. Kiddoo and V. C. Ratliff.

Stow Mfg. Co., Binghamton, N. Y.; $60,000; flexible shafts, etc.; C. F. Hotchkiss and W. C. Hawes.

Western Ballast Co., Aurora, Ill.; $100,000; Jesse Stubbs, Charles H. Smith and T. H. Bereman.

Prosser Steam Engine Co., Chicago, Ill.; $1,000,000; Henry B. Prosser, Oscar E. Poole and John Marsh.

St. Louis Asphalt & Paving Co., St. Louis, Mo.; $10,000; Griffith Colt, M. Kraemer and J. E. Weber.

Indiana Hedge & Wire Fence Co., Indianapolis, Ind.; $300,000; Sterling R. Holt, E. J. Robinson and Thomas Taggart.

Weldless Tube & Steel Co., Pittsburg, Pa.; $1,000; Treas., James C. Clow, 201 Ferguson Building, Pittsburg, Pa.

Phillipsburg Fire Brick Works, Philadelphia, Pa.; $10,000, with $1,000 paid in; Alpheus M. Walker, Norbeth, Pa.

Ohio River Sheet & Tin Plate Co., Pittsburg, Pa.; $50,000, with $5,000 paid in; Treas., Matthias Sweeney, Demmler, Pa.

Glen Hazel Gas Co., Bradford, Pa.; $50,000, with $5,000 paid in; piping and storing natural gas. Treas., C. V. Merrick.

New York Compressed Air Motor Co., New York, N. Y.; $4,000; A. L. Washburn, J. L. Schofield and J. N. B. Bond.

Stedman Automatic Street Railway Switch Co., Portland, Me.; $600,000; Pres., W. F. Steadman, Quincy, Mass.

Consolidated Cattle Car Co., East St. Louis, Ill.; $2,000,000; Edward S. Roberts, Daniel G. Taylor and Ebenezer Smith.

Perfected Rail Joint Co., Portland, Me.; $500,000; D. A. Chapin, Benjamin Noyes and Chapman Seabury, all of Boston, Mass.

Vibration-Proof Nut Co., New York, N. Y.; Edward Stanciff and W. L. Clark, of New York, and Thomas Orgill, of Brooklyn.

R. H. Johnson Co., Wayne, Pa.; $25,000, with $2,500 paid in; quarrying, crushed stone, etc.; Fred A. Canizares, Wayne, Pa.

R. S. Newbold & Co., Norristown, Pa.; $100,000, with $10,000 paid in; iron and steel manufacture; Treas., John D. Newbold.

Mount Vernon Telephone & Messenger Co., Mount Vernon, N. Y.; $40,000; C. H. Ostrander, William Archer and John Dawson.

McAvoy Vitrified Brick Co., Philadelphia, Pa.; $250,000, with $2,500 paid in. Pres., B. McAvoy, 1422 Parker St., Philadelphia, Pa.

Wiseman's Automatic Safety Railway Switch Co., Chicago, Ill.; $1,000,000; Theodore Wiseman, Albert L. Coe and Thomas H. Kelly.

Fidelity Improvement Co., Jersey City, N. J.; $50,000, all paid in; construction work; James H. Fielder, F. L. Clark and George R. Percy.

Erie Dock & Transportation Co., Erie, Pa.; $150,000, with $15,000 paid in; shipbuilding, transportation, etc.; Treas., Harry F. Watson, Erie, Pa.

California Natural Gas, Oil & Land Co., San Francisco, Cal.; $1,000,000, with $100 paid in; L. L. James, Thomas Sterrett and F. M. Smith.

Hercules Brick Machine Co., New York, N. Y.; $250,000; John B. Conkling and Philip Hathaway, of New York; Israel Cook, of Brooklyn, N. Y.

International Forging Co., New York, N. Y.; electric smelting and forging; $6,000; James Seager, of New York, and J. L. Ullo, of Brooklyn.

New York Iron & Steel Construction Co., New York, N. Y.; $25,000; C. E. Spencer, of New York; J. J. Henry and P. F. Hansen, of Brooklyn.

Fulton Machine Co., Canal Fulton, N. Y.; $10,000; dump cars, road rollers, foundry work; Edwin E. Porter, Adam Kurtz and George W. Miller.

Wayland Portland Cement Co., Wayland, N. Y.; $100,000; Jacob B. Whitman, of Wayland; John N. Rauber and William Vicinus, of Rochester, N. Y.

Cycloidal Transit Amusement Co., Jersey City, N. J.; $150,000, with $75,000 paid in; Wm. D. Cronin, Charles A. Baake and Louis Kumpf, all of Atlantic City, N. J.

Rancocas Sand & Gravel Co., Hainesport, N. J.; $50,000, with $1,000 paid in; Charles G. Reeve, of Camden, N. J., and Henry Delaplaine, of Philadelphia, Pa.

Consolidated Gas Co., Jersey City, N. J.; $750,000, with $1,000 paid in; Joseph C. Davis, Maplewood, N. J.; George Place and Henry A. Jones, New York, N. Y.

Bonta Mfg. Co., Hoboken, N. J.; $150,000, with $1,000 paid in; electrical machinery; Arthur K. Bonta and Wilbur C. Anderson, of Hoboken, and Jacob Wendell, of New York, N. Y.

Esmond Electric Block Signal Co., Jersey City, N. J.; $100,000, with $1,000 paid in; Frederick C. Esmond, Brooklyn, N. Y.; Charles C. Dodge, New York, N. Y.; Henry Seligman, Hastings, N. Y.

A FAR-REACHING MISTAKE.

In our issue of April 11 there appeared a short item stating that a Mr. Bliss, of Los Angeles, Cal., would receive bids until May 6 for the construction of certain bridges. The "Engineering Record," of New York, and contract papers in Washington, Chicago and other cities during the following week told their readers about Mr. Bliss and his bridges, and daily newspapers in the large cities, which have recently added departments of "Unawarded Contracts," "Construction Matters," etc.—all established within a year, and since this department of Engineering News became so popular—have all told their readers this story about Mr. Bliss. All this error was caused by an apparently unimportant mistake made in this office. A Mr. Diss advertised for bridge bids, as noted in all these news items, but in none of the advertisements is the word spelled Bliss, and nowhere had it appeared in that way, to our knowledge, until the week following the error in Engineering News.